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FINAL SUBMITTAL

ENERGY SURVEYS OF  
ARMY INDUSTRIAL FACILITIES  
ENERGY ENGINEERING ANALYSIS PROGRAM  
LETTERKENNY ARMY DEPOT  
CHAMBERSBURG, PENNSYLVANIA

VOLUME II  
APPENDICES

CONTRACT NO. DACA65-91-C-0071

PREPARED FOR:

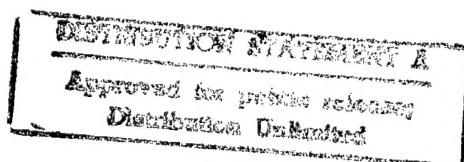
U.S. ARMY CORPS OF ENGINEERS  
NORFOLK, VIRGINIA

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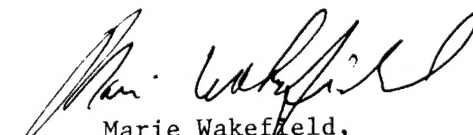


DEPARTMENT OF THE ARMY  
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REPLY TO  
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Marie Wakefield,  
Librarian Engineering

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**AND**  
**SCOPE OF WORK**



## PRENEGOTIATION MINUTES

Attendees: Dick Faith, LEAD  
Jeff Hager, LEAD  
Tom Hagie, LEAD  
Paul Hutchins, RS&H  
Bryant Williams, COE, Norfolk

Location: Letterkenny Army Depot, Bldg. 663

Date: December 5, 1990

The general scope of work was discussed and LEAD personnel were invited to list specific areas of interest.

- Several studies should be reviewed:
  - Larson Report on Boilers
  - EMCS Report--BKA
  - People's Gas Report--Natural Gas Conversion
  - Paint Booth--BKA
- Major energy users:
  - Dip tanks--37, 57, 350 and 370
  - Paint booths--37, 57, 320, 350 and 370
  - Steam cleaning--37, 57 and 351
- Heat recovery wheel in 370 has been a problem--plugged filters
- Would like a boiler monitoring system--system in Fire Department may be expandable
- Building 370--Air conditioning is being changed--biggest electricity user
- Buildings 3 and 10 use air conditioning year round
- EMCS is old--1975 Delta 1000
- Be certain to show assumptions

SCOPE OF WORK

CEHND-ED-ME

January 1991

GENERAL SCOPE OF WORK  
FOR AN  
ENERGY SURVEY OF ARMY INDUSTRIAL FACILITIES  
LETTERKENNY ARMY DEPOT

Performed as part of the  
ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

SCOPE OF WORK  
FOR AN  
ENERGY SURVEY OF ARMY INDUSTRIAL FACILITIES

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1. BRIEF DESCRIPTION OF WORK: The Architect-Engineer (AE) shall:

1.1 Perform a complete energy audit and analysis of the industrial facility.

1.2 Identify all Energy Conservation Opportunities (ECOs) including low cost/no cost ECOs and perform complete evaluations of each.

1.3 Prepare programming and implementation documentation for all justifiable energy conservation opportunities.

1.4 List and prioritize all recommended energy conservation opportunities.

1.5 Prepare a comprehensive report which will document the work accomplished, the results and the recommendations.

2. GENERAL

2.1 A coordinated energy study, including a detailed energy survey, shall be accomplished for the industrial facility. The study shall integrate the results of and any available data from prior or ongoing energy conservation studies, projects, designs, or plans. This Scope of Work is not intended to prescribe the methods in which the study is to be conducted or limit the AE in the exercise of his professional engineering expertise, good judgment or investigative ingenuity. However, the information and analyses outlined herein are considered to be minimum essentials for adequate performance of this study. The study shall include a comprehensive energy report documenting study methods and results.

2.2 All ECOs recommended shall comply with all current criteria (e.g., environmental, safety) for the industrial facility. These criteria may have changed since the facility was constructed. Replacement of people with automation systems may allow reductions in outside air quantities, ventilation rates, and similar items resulting in significant energy savings. Stated requirements for special environments (temperature/humidity control) for industrial equipment and processes shall be researched as needed by the AE to verify (a) the requirement and (b) the degree of control essential for the industrial mission.

2.3 All recommended ECOs, including maintenance, operational and low cost/no cost opportunities as well as Energy Conservation Investment Program (ECIP) and Energy Conservation and Management Program (ECAM) projects shall be ranked in order of highest to lowest Savings to Investment Ratio (SIR).

2.4 Other studies performed under the Energy Engineering Analysis Program (EEAP) have been accomplished for the installation. Applicable portions of the studies if any, shall be updated as needed and incorporated into the report. The report shall list the recommended ECOs from the previous studies that pertain or should pertain to industrial facilities processes. This list shall summarize the ECOs (cost, short description, and anticipated energy savings) and identify the fiscal year for which the project was or is programmed. Any industrial facility related ECO identified in the previous studies but not recommended shall be reevaluated under this contract. Any industrial facility related ECO recommended from the previous studies but not implemented nor programmed for implementation shall be updated and in accordance with the latest ECIP criteria.

2.5 The terms "industrial", "production", and "process" are used interchangeably in this Scope of Work and should be interpreted broadly to include research, test and development, end item maintenance and repair, supply and distribution, as well as the typical "production centers" in Army industrial facilities. The term "facility" means one or more buildings or enclosures together with the equipment installed therein. It implies an integrated production system which requires a coordinated approach to achieve the best overall results.

2.6 The "Energy Conservation Investment Program (ECIP) Guidance," described in letter from CEHSC-FU, dated 25 April 1988 and revised by letter from CEHSC-FU-P, dated 15 June 1989, establishes criteria for ECIP/ECAM Projects and shall be used for performing the economic analyses of all ECOs and projects. Construction cost escalation for DD Form 1391 submission shall be calculated using the guidelines contained in AR 415-17 and the latest Tri-Service MCP index. The Tri-Service MCP Index, when updated, is contained in the latest applicable edition of the Engineer Improvement Recommendation System (EIRS) bulletin.

2.7 Energy conservation opportunities determined to be technically and economically feasible shall be developed into projects acceptable to installation personnel. This may involve combining similar ECOs into larger packages which will qualify for ECIP/ECAM or MCA funding, and determining, in coordination with installation personnel, the appropriate packaging and implementation approach for all feasible ECOs.

2.8 Projects which qualify for ECIP/ECAM funding shall be identified, separately listed, and prioritized by Savings to Investment Ratio.

2.9 All energy conservation opportunities shall be listed and prioritized by SIR.

### 3. WORK TO BE ACCOMPLISHED

3.1 Audit. The audit consists of gathering data and inspecting industrial facilities in the field, including those which are government-owned, contractor operated (GOCO). These activities shall be closely coordinated with the contractor operator at GOCOs, facilities or plant engineer representatives, production engineers, the installation commander or his representative, and the Government's representative. The AE shall become thoroughly familiar with the facility and its industrial mission and undertake all necessary field trips to obtain required data. The AE shall consolidate or summarize the survey data to make it concise, and shall submit the summarized data as part of the report. Data sources shall be identified and assumptions clearly stated and justified. All test and/or measurement equipment shall be properly calibrated prior to its use.

3.1.1 Boiler plants, chilled water plants, incinerators, and similar facilities listed in Annex D that are associated with the industrial facility shall be included in the study. The intent is to determine the condition of existing equipment, efficiency of boiler plant equipment, operational procedures, adequacy of plant capacity, and heat recovery possibilities in addition to the general items listed.

3.1.2 During the audit process promising applications of solar energy for industrial processes shall be identified. Tremendous amounts of steam and hot water are used in industrial facilities dictating active consideration and analysis of potential solar applications.

3.1.3 The audit shall be conducted with the view that the term "industrial facility" means an integrated production infrastructure including the building envelope, industrial equipment, process standards, materials, utilities and other components of the industrial operation which have an energy value. Envelope energy and process energy are interrelated. Inputs and outputs, particularly of thermal energy, should be balanced in order to optimize overall energy efficiency of industrial facilities. ECOs should therefore reflect the "systems" approach for a totally integrated facility, and assure that any energy tradeoffs between buildings and processes are analyzed.

3.1.4 Data collected during the audit shall, as a minimum, include:

#### 3.1.4.1 Building data.

a. Building number, building age, number of floors, and gross square feet.

b. Floor area, HVAC zones, nonair-conditioned spaces, and usage of space ("industrial" or "other").

c. Glass areas.

d. Wall and roof surface areas and condition, type of construction, and "U" factors.

e. Drawings, equipment schedules, shop layouts, utilities distribution diagrams, etc.

f. Nameplate data of energy related building equipment.

g. Any major expansions, alterations, or modernization projects.

3.1.4.2 Weather information.

3.1.4.3 Operating methods.

a. Facilities operating hours (peacetime).

b. Personnel strength (direct labor).

c. Facilities system and equipment operating and maintenance schedules.

d. Control set points, chilled water temperatures, and freeze protection temperatures.

e. Rooms, areas, or zones with special or critical requirements.

3.1.4.4 Past performance records.

a. Energy peak demands.

b. Latest annual energy consumption (Gross BTU/yr, BTU/SF/yr, BTU/end product/yr) for total installation and facility(ies) being studied.

c. Utility rate schedules.

d. Energy conservation projects (ECIP/ECAM/other) in facilities being studied.

3.1.4.5 Energy sources.

3.1.4.6 Production data.

a. Production areas by type utilization (e.g., fabrication, finishing, assembly, test, storage, etc.).



- b. Production equipment schedules, age, utilization, and energy requirements.
- c. Production equipment replacement or modernization plans.
- d. Process flow layouts.
- e. Production rates/quantities.
- f. Material handling systems.
- g. Expected changes (equipment, process, facilities, workload, etc.).

3.2 Analysis. The energy analysis is a comprehensive study of the industrial facilities energy usage. It includes a detailed investigation of the operation, environment and equipment. The AE shall use generally accepted energy calculations techniques, which are fully documented. For complex buildings, computer modeling shall be used to incorporate field survey data, weather data, production data, occupancy schedules, building construction data, energy distribution systems and equipment data into a model of the total facility. The computer program shall, for varying production rates (peacetime levels and full mobilization), develop load profiles, calculate energy savings, and evaluate the energy requirements of the industrial facility. The computer results should be verified by comparing them to any available past utility bills or records. Acceptable computer programs are listed in Annex D. If a different program is to be used, the AE shall submit a sample computer run with an explanation of all input and output data, and a summary of program methodology and energy evaluation capabilities for approval by the Contracting Officer prior to use of the program for analysis.

A regression analysis will be performed on the installation historical energy data. The purpose will be to determine what variables affect the energy use at the installation and to what degree. Typical variables to be studied are heating degree-days, cooling degree-days and population. Others will also be sought with the intent to find the best correlation.

3.2.1 The energy analysis shall provide the following types of information:

- a. A baseline of energy usage of the existing facility (at current production capacity prior to implementing ECOs generated by this study).
- b. Comparison of equipment capacities with current workloads.
- c. Energy usage by systems (lighting, heating, cooling, process, etc.).
- d. Basis for evaluating ECOs.
- e. A baseline of energy usage of the facility after incorporation of all recommended ECOs (assuming no change in production level).

3.2.2 The AE shall develop graphic presentations, i.e. graphs and charts which depict a complete energy consumption picture for the industrial facility both presently and after implementation of energy conservation opportunities and include these in the report.

3.2.3 The AE shall develop a listing of each shop, zone, or area of the facility as appropriate. The list shall include the air handling system and humidity setpoints, lighting levels, number and types of light fixtures, differential pressure readings and similar data required for the analysis. The valid criteria requirements for supply, return and exhaust air quantities, temperature and humidity setpoints, lighting levels, etc., shall also be shown. The listing shall be in sufficient detail so that areas with potential energy savings can be identified. The AE shall be familiar with the latest Army environmental and safety criteria and shall evaluate installed systems for possible energy saving revisions which may be permitted by current criteria.

3.2.4 If data is available, the AE shall develop an historical load profile by year for the past three fiscal years for each energy source utilized.

3.2.5 The AE shall project energy costs for three fiscal years from the date of contract award. Department of Energy (DOE) projections are acceptable.

3.3 Identify ECOs. All methods of energy conservation which are reasonable and practical shall be considered, including improvements of operational methods and procedures and maintenance practices as well as the physical facilities. A list of energy conservation opportunities is included as Annex A to this scope. This list is not intended to limit or guide the AE but only to assure that at least these opportunities are considered, discussed and documented in the report. Those items on the list which are not practical, have been previously accomplished, are inappropriate or can be eliminated from detailed analysis based on preliminary analysis shall be listed in the report along with the reason for elimination from further analysis. All potential ECOs which are not eliminated by preliminary considerations shall be thoroughly documented and evaluated as to technical and economic feasibility. The AE shall provide all data and calculations needed to support the recommended ECO. All assumptions shall be clearly stated. Calculations shall be prepared showing how all numbers in the ECO were figured. Calculations shall be an orderly step-by-step progression from the first assumption to the final number. Descriptions of the products, manufacturers catalog cuts, pertinent drawings, and sketches shall also be included). A life cycle cost analysis summary sheet shall be prepared for each ECO and included as part of the supporting data.

### 3.4 Energy Monitoring and Control Systems (EMCS)/Process Control System (PCS).

3.4.1 The AE shall determine the feasibility of single building EMCS/PCS for those buildings listed in Annex B. The intent of this study is to determine on a building-by-building basis, the feasibility of implementing an EMCS/PCS where existing HVAC and process controls are of sound condition and quality to warrant the additional expense. The documentation shall be of sufficient accuracy to insure that future project design calculations that will be done after completion of this study will not deviate more than 20 percent from the results of this study.

3.4.2 The AE shall perform feasibility evaluations in accordance with guidance in HNDSP-84-076-ED-ME. The use of existing survey data is acceptable only if it is in sufficient detail and can be easily revalidated by building walk through inspections. The standard evaluation forms contained in HNDSP84-076-ED-ME shall be a part of the submittal. EMCS/PCS analyses and evaluations shall be developed using TM 5-815-2. EMCS costs shall be developed using the Cost Estimating Guides--HNDSP88-207-ED-ME, HNDSP88-208- ED-ME, HNDSP88-209-ED-ME or HNDSP88-210-ED-ME--depending on size. Energy savings calculations shall be in accordance with NCEL CR 82.030. EMCS/PCS evaluations shall consider but not be limited to the following features:

#### a. Start/Stop Programs

- Load shedding for electrical demand limiting
- Lighting control
- Start/Stop Optimization

#### b. Ventilation and Recirculation Programs

- Dry bulb economizer
- Outside air reduction
- Industrial process economizer
- Exhaust air reduction/optimization (based on production activity)

#### c. Temperature Reset Programs

- Space temperature night setback
- Process temperature night setback

d. Labor Savings/Monitoring (Example: Boiler plant monitoring (EMCS/PCS logging of points which are present are manually logged.)

e. Machine run time, production profiles and maintenance management

3.4.3 The AE's recommendations for an EMCS/PCS shall be in sufficient detail to define the system configuration, the approximate quantity and types of control instruments and sensors, and the data transmission system. The selection of points to be monitored and controlled shall be given priority based upon ECIP criteria. The control system functions, expected energy reduction, and monetary savings (including the manner in which these savings are to be achieved) shall be explained.

3.4.4 The AE shall prepare and provide recommendations in narrative form. Input/output (I/O) summary tables shall be prepared and provided for each system selected in accordance with HNDSP-84-076-ED-ME. Cost estimates shall be prepared and provided in accordance with the Cost Estimating Guides for the mechanical and electrical modifications required to implement the EMCS/PCS.

3.4.5 Inoperative controls shall be surveyed in accordance with TM 5-815-2. Cost estimates to repair and replace inoperative controls shall be as described in the Cost Estimating Guides.

3.4.6 Labor savings/monitoring shall be included, provided the SIR is not affected to the extent of jeopardizing the ECIP requirements.

3.5 Project Documentation. All energy conservation opportunities the AE has considered shall be included in one of the following categories and presented as such in the report:

3.5.1 ECIP/ECAM Projects. To qualify as an ECIP/ECAM project, an ECO, or several ECOs which have been combined, must have a construction cost estimate greater than \$200,000 and Savings to Investment Ratio greater than one and a simple payback period of less than eight years. For ECAM projects, the \$200,000 limitation

Savings to Investment Ratio greater than one and a simple payback period of less than eight years. For ECAM projects, the \$200,000 limitation may not apply. The AE shall check with the installation for guidance. The overall project, and each discrete part of the project, shall have a SIR greater than one. For all projects meeting the above criteria, complete programming documentation will be required. Programming documentation shall consist of a DD Form 1391, life cycle cost analysis summary sheet(s) (with necessary backup data to verify the numbers presented), and a project development brochure (PDB). These forms shall be separate from the report. They shall be bound similarly to the final report in a manner which will facilitate repeated disassembly and reassembly. A life cycle cost analysis summary sheet shall be developed for each ECO and for the overall project when more than one ECO is combined. For projects and ECOs updated or developed from the previous studies, the backup data shall consist of copies of the original calculations and analysis, with new pages updating and revising the original calculations and analysis. In addition, the backup data shall include as much of the following as is available: the increment of work the project or ECO was developed under in the previous study, title(s) of the project(s), the energy to cost (E/C) ratio, the benefit to cost (B/C) ratio, the current working estimate (CWE), and the payback period. This information shall be included as part of the backup data. The purpose of this information is to provide a means to prevent duplication of projects in any future reports. For projects or ECOs the installation wants submitted as ECIP/ECAM projects, complete programming documentation shall be prepared.

3.5.1.1 Military Construction Project Data (DD Form 1391). These documents shall be prepared in accordance with AR 415-15 and the supplemental requirements in Annex B. A complete DD Form 1391 shall be prepared for each project. The form shall include a statement that the project results from an EEAP study. Documents shall be complete as required for submission to higher DA headquarters. These programming documents will require review and signatures by the proper installation officials. All documents shall be complete except for the required signatures.

3.5.1.2 Project Development Brochures (PDBs). Preparation of PDBs requires the AE to delineate the functional requirements of the project as related to the specific site. The AE shall prepare PDBs in accordance with AR 415-20 and TM 5-800-3. Most projects will not require all the forms and checklists included in the Technical Manual (TM). Only that information needed for the project shall be included. The PDB-I format described in the TM shall be used for whatever information is needed.

3.5.2 Non-ECIP/ECAM Projects. Projects which normally do not meet ECIP/ECAM criteria, but which have an overall SIR greater than one shall be individually packaged and fully docu-

mented and included as a separate section in the volume containing the programming documentation. The life cycle cost analysis summary sheet shall be completed through and including line 6 for all projects or ECOs. Each shall be analyzed to determine if they are feasible even if they do not meet ECIP/ECAM criteria. These ECOs or projects may not meet the nonenergy qualification test. For projects or ECOs which meet this criteria, the life cycle cost analysis summary sheet, completely filled out, with all the necessary backup data to verify the numbers presented, a complete description of the project and the simple payback period shall be included in the report. Additionally, these projects shall have the necessary documentation prepared, in accordance with the requirements of the Government's representative, for one of the following categories:

a. Quick Return on Investment Program (QRIP). This program is for projects which have a total cost not over \$100,000 and a simple payback period of two years or less.

b. OSD Productivity Investment Funding (OSD PIF). This program is for projects which have a total cost of more than \$100,000 and a simple payback period of four years or less.

c. Productivity Enhancing Capital Investment Program (PECIP). This program is for projects which have a total cost of more than \$100,000 and a simple payback period of four years or less.

The above programs are described and documentation shall be prepared in accordance with AR 5-4, Change No. 1. A sample implementation document, consisting of a DA Form 5108-R, sketches and manufacturers data and a life cycle cost analysis summary sheet, shall be submitted for review and approval with the interim submittal. This sample shall be submitted and approved prior to the preparation of any other implementation documentation. To the degree possible, the project selected for the sample submission shall be typical of the majority of subsequent projects to be submitted. The sample shall consist of complete implementation documentation with primary emphasis on format and manner of presentation rather than precise accuracy of cost estimates and energy saving data.

d. Regular Military Construction Army (MCA) Program. This program is for projects which have a total cost greater than \$200,000 and a simple payback period of eight to twenty-five years. Projects or ECOs which qualify for this program shall be economically analyzed in accordance with the requirements for Special Directed Studies in Engineering Technical Letter (ETL) 1110-3-332. Documentation shall be in accordance with paragraph 3.5.1 except that the economic analysis required by ETL 1110-3-332 shall be included in lieu of the ECIP life cycle cost analysis.



e. Low Cost/No Cost Projects. These are projects that the installation can perform using their resources. For these projects the following information shall be provided:

- (1) Brief description of the project.
- (2) Brief description of the reasons for the modification.
- (3) Specific instructions for performing the modification.
- (4) Estimated dollar and energy savings per year.

(5) Estimated manhours and labor and materials costs. Costs shall be calculated for the current calendar year and so marked. Manhours shall be listed by trade. For projects that would repair an existing system so that it will function properly, also include the estimated manhours by trade and labor and material costs necessary to maintain the system in that condition. Some of the simple practical modifications may be developed on a per unit basis. An example of this type of modification would be the repair or replacement of steam traps on an as needed basis. As a rule, however, the AE should develop complete projects, if at all possible, rather than per unit modifications.

Separate sheets for each project showing the above information shall be prepared and included in the report.

3.5.3 Nonfeasible ECOs. All ECOs which the AE has considered but which are not feasible, shall be documented in the report with reasons and justifications showing why they were rejected.

4. DETAILED SCOPE OF WORK: The general Scope of Work is intended to apply to contract efforts for all Army industrial facilities except as modified by the detailed Scope of Work for each specific installation. The detailed Scope of Work is contained in Annex D.

## 5. PROJECT MANAGEMENT

5.1 Project managers. The AE shall designate a project manager to serve as a point of contact and liaison for all work required under this contract. Upon award of this contract, the individual shall be immediately designated in writing. The AE's designated project manager must be approved by the Contracting Officer prior to commencement of work. This designated individual shall be responsible for coordination of work under this contract. The Contracting Officer will designate a project manager to serve as the Government's point of contact and liaison for all work required under this contract. This individual will be the Government's representative.

5.2 Installation assistance. The Commanding Officer or contractor operator at each installation will designate an individual who will serve as the point of contact for obtaining information and assisting in establishing contacts with the proper individuals and organizations as necessary to accomplish the work required under this contract.

5.3 Public disclosures. The AE shall make no public announcements or disclosures relative to information contained or developed under this contract, except as authorized by the Contracting Officer.

5.4 Meetings. Meetings will be scheduled whenever requested by the AE or the Contracting Officer for the resolution of questions or problems encountered in the performance of the work. The AE and/or the designated representative(s) shall be required to attend and participate in all meetings pertinent to the work required under this contract as directed by the Contracting Officer. These meetings, if necessary, are in addition to the presentation and review conferences.

5.5 Site visits, inspections, and investigations. The AE, consultants, if applicable, and/or designated representative(s) thereof shall visit and inspect/investigate the site of the project as necessary and required during the preparation and accomplishment of the work.

#### 5.6 Records

5.6.1 The AE shall provide a record of all significant conferences, meetings, discussions, verbal directions, telephone conversations, etc., with Government representative(s) relative to this contract in which the AE and/or designated representatives(s) thereof participated. These records shall be dated and shall identify the contract number, and modification number if applicable, participating personnel, subject discussed and conclusions reached. The AE shall forward to the Contracting Officer within ten (10) calendar days, a reproducible copy of the records.

5.6.2 The AE shall provide a record of requests for and/or receipt of Government-furnished material, data, documents, information, etc., which if not furnished in a timely manner, would significantly impair the normal progression of work under this contract. The records shall be dated and shall identify the contract number and modification number, if applicable. The AE shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the record or request or receipt of material.



## 6. SUBMITTALS, PRESENTATIONS AND REVIEWS

6.1 General. The work accomplished shall be fully documented by a comprehensive report. The report shall have a table of contents and be indexed. Tabs and dividers shall clearly and distinctly divide sections, subsections, and appendices. All pages shall be numbered. The AE shall give a formal presentation of all but the final submittal to installation, command, and other Government personnel. The AE shall prepare slides or view graphs showing the results of the study to date for his presentation. During the presentation, the personnel in attendance shall be given ample opportunity to ask questions and discuss any changes deemed necessary to the study. A review conference will be conducted the same day, following the presentation. Each comment presented at the review conference will be discussed and resolved or action items assigned. The AE shall provide the comments from all reviewers and written notification of the action taken on each comment to all reviewing agencies within three weeks after the review meeting. It is anticipated that each presentation and review conference will require approximately one working day. The presentation and review conferences will be at the installation on the date(s) agreeable to the industrial facilities personnel, the Director of Engineering and Housing, the AE and the Government's representative. The Contracting Officer may require a resubmittal of any document(s), if such document(s) are not approved because they are determined by the Contracting Officer to be inadequate for the intended purpose.

6.2 Interim Submittal. An interim report shall be submitted for review after completion of the field survey and an analysis has been performed on all of the ECOs. The report shall indicate the work which has been accomplished to date, illustrate the methods and justifications of the approaches taken and contain a plan of the work remaining to complete the study. Calculations showing energy and dollar savings and SIRs of all the ECOs shall be included. The simple payback period of all ECOs shall be calculated and shown in the report. The AE shall submit the Scope of Work and any modifications to the Scope of Work as an appendix to the report. A narrative summary describing the work and results to date shall be a part of this submittal. During the review period, the Government's representative shall coordinate with the industrial facilities personnel, and the Director of Engineering and Housing and provide the AE with direction for packaging or combining ECOs for programming purposes and also indicate the fiscal year for which the programming or implementation documentation shall be prepared. A sample implementation document (DA Form 5108-R, sketches and manufacturers data, life cycle cost analysis summary sheet and supporting data) for one project shall be submitted with this submittal for review and approval. The survey forms completed during this audit shall be submitted with this report. The survey forms only may be submitted in final

form with this submittal. They should be clearly marked at the time of submission that they are to be retained. They shall be bound in a standard three-ring binder which will allow repeated disassembly and reassembly of the material contained within.

6.3 Prefinal Submittal. The AE shall prepare and submit the prefinal report when all work under this contract is complete. The AE shall submit the Scope of Work for the installation studied and any modifications to the Scope of Work as an appendix to the submittal. The report shall contain a narrative summary of conclusions and recommendations, together with all raw and supporting data, methods used, and sources of information. The report shall integrate all aspects of the study. The report shall include an order of priority by SIR in which the recommended ECOs should be accomplished. The synergistic effects of all of the ECOs on one another shall have been determined and the results of the original calculations adjusted accordingly. Completed programming and implementation documents for all recommended projects shall be included. The programming and implementation documents shall be ready for review and signature by the installation commander. The prefinal report, separately bound Executive Summary and all appendices shall be bound in standard three-ring binders which will allow repeated disassembly and reassembly. The prefinal submittal shall be arranged to include (a) a separately bound Executive Summary to give a brief overview of what was accomplished and the results of this study using graphs, tables and charts as much as possible (See Annex C for minimum requirements), (b) the narrative report containing a copy of the Executive Summary at the beginning of the volume and describing in detail what was accomplished and the results of this study, (c) appendices to include the detailed calculations and all backup material and (d) the programming and implementation documentation. A list of all projects and ECOs developed during this study shall be included in the Executive Summary and shall include the following data from the life cycle cost analysis summary sheet: the cost (construction plus SIOH), the annual energy savings (type and amount), the annual dollar savings, the SIR, the simple payback period and the analysis date. For all programmed projects also include the year in which it is programmed and the programmed year cost.

6.4 Final Submittal. Any revisions or corrections resulting from comments made during the review of the prefinal report or during the presentation and review conference shall be incorporated into the final report. These revisions or corrections may be in the form of replacement pages, which may be inserted in the prefinal report, or complete new volumes. Pen and ink changes or errata sheets will not be acceptable. If replacement pages are to be issued, it shall be clearly stated with the prefinal submittal that the submitted documents will be changed only to comply with the comments made during the prefinal conference and that the volumes issued at the time of the prefinal

submittal should be retained. Failure to do so will require resubmission of complete volumes. If new volumes are submitted, they shall be in standard three-ring binders and shall contain all the information presented in the prefinal report with any necessary changes made. Detailed instructions of what to do with the replacement pages should be securely attached to the replacement pages.

7. OPERATION AND MAINTENANCE INSTRUCTION. The AE shall prepare a one-day instructional course for the mechanical and electrical operation and maintenance personnel and affected production supervisors to explain possible energy saving potentials due to modified equipment and systems operation. The course will identify operational items noted during the audit, in both facilities and process areas, which will effect energy conservation, and will explain and savings possible. This course will be held near the end of the study period at a time agreeable to the AE and the Government representative. This course is in addition to the formal review and presentations required. An outline of the topics that will be covered shall be submitted with the prefinal report.

8. ENTRY AND EXIT INTERVIEWS. The AE and the Government's representative shall conduct entry and exit interviews with the Facilities or Plant Engineer and other interested managers before starting work at the facility and after completion of the field work. The Government's representative shall schedule the interviews at least one week in advance.

8.1 The entry interview shall thoroughly describe the intended procedures for the survey. As a minimum, the interviews shall cover the following points:

- a. Schedules.
- b. Names of energy analysts who will be conducting the site survey.
- c. Proposed working hours.
- d. Support requirements from the facilities or plant engineer.
- e. Limitations imposed by production operations.
- f. Plant security and safety procedures.

8.2 The exit interview shall include a thorough briefing describing the work accomplished, problems encountered, probable areas of energy conservation, and any follow-on efforts which may be required.

9. SERVICES AND MATERIALS. All services, supplies, materials (except those specifically enumerated to be furnished by the Government), plant, labor, superintendence and travel necessary to perform the work and render the data required under this contract shall be included in the lump sum price of the contract.

## ANNEX A

### ENERGY CONSERVATION OPPORTUNITIES (ECOs)

ECOs shall not be recommended if their implementation would be detrimental to the facility's mission during peacetime. ECOs which may pose a constraint on mobilization production requirements shall include an analysis thereof, along with recommended contingency actions. Industrial process ECOs shall include, but not be limited to, the following:

- o Production equipment replacements, modifications, disposals.
- o Energy efficient motors and variable frequency drives..
- o Scheduling/loading of production equipment.
- o Waste heat recovery from industrial processes.
- o Automated control of production equipment, integrated with existing or proposed EMCS equipment, if appropriate.
- o Improve facility layout and space utilization.
- o Solar applications.
- o Consolidate processes and equipment requiring special environments.
- o Building ventilation, exhaust systems.
- o Production equipment maintenance.
- o Improved methods/controls to reduce scrap, rework, and "goldplating", which consume energy without contributing to production mission.
- o Steam distribution and condensate return systems.
- o Compressed air distribution systems.
- o Lighting control (zones, levels, etc.).
- o Electrical Distribution.
- o Radiant heating.
- o Loading dock seals.
- o Thermal storage.

- o Reflectors for fluorescent fixtures.
- o Water Spray roof cooling.
- o Occupancy sensors to control lighting or HVAC.
- o Photocells to control lighting.
- o Timers to control lighting.
- o Separate switches to control lighting arrangements.
- o Efficient lighting

ANNEX B

REQUIRED DD FORM 1391 DATA

To facilitate ECIP/ECAM project approval, the following supplemental data shall be provided:

a. In title block, clearly identify project as "ECIP" or "ECAM."

b. Complete description of each item of work to be accomplished including quantity, square footage, etc.

c. A comprehensive list of building zones, or areas including building numbers, square foot floor area and usage (administration, production, etc.).

d. Complete list of production equipment, process controls and ancillary equipment to be installed or retrofitted.

e. List references, assumptions and provide calculations to support life cycle dollar and energy savings and indicate any added costs.

(1) If a specific building, zone or area is used for sample calculations, identify the building, zone or area, category, age, square footage floor area, window and wall area for such. For a specific piece of production equipment or system, provide complete description, environmental requirement, manner of operation, age, etc.

(2) Identify weather data source, if applicable.

(3) Compare process-building systems interface before and after improvements.

(4) Provide and justify process criteria and temperature profiles before and after retrofit of buildings or modification of process. Include source of expertise and demonstrate savings claimed by process energy contributions, exhaust or outside air quantities, temperatures, humidity, production flow, etc.

f. Recommended process/equipment efficiency improvements must identify data to support present properly adjusted operation and future expected efficiency. If full replacement of equipment is indicated, explain rejection of alternatives such as repair, nonfunctioning controls, etc. Assessment of the complete existing installation is required to make accurate determinations of required retrofit/replacement.

g. An ECIP/ECAM life cycle cost analysis summary sheet as shown in the ECIP guidance will be provided for the complete project and for each discrete part included in the project. The SIR is applicable to all segments of the project. Supporting documentation consisting of basic engineering and economic calculations showing how savings were determined shall be included.

h. The DD Form 1391 face sheet shall include, for the complete project, the annual dollar and MBTU savings, SIR, simple payback period and a statement attesting that all buildings and production equipment will be in active use throughout the amortization period.

i. The calendar year in which the cost was calculated shall be clearly shown on the DD Form 1391.

j. For each temporary building included in a project, separate documentation is required showing (1) a minimum 10-year continuing need, based on the installation's annual real property utilization survey, for active building retention after retrofit, (2) the specific retrofit action applicable, and (3) an economic analysis supporting the specific retrofit.

k. Nonappropriated funded facilities will not be included in the ECIP project without an accompanying statement certifying that utility costs are not reimbursable.

l. Any requirements required by ECIP guidance, dated 25 April 1988 and revisions thereto. Note that unescalated costs/savings are to be used in the economic analyses.

m. The five digit category code number for all ECIP/ECAM projects developed under this scope of work is 80000.



## ANNEX C

### EXECUTIVE SUMMARY GUIDELINE

1. Introduction.
2. Building Data.
3. Present Energy Consumption.
  - o Total Annual Energy Used.
  - o Source Energy Consumption.
    - Electricity - KWH, Dollars, BTU
    - Fuel Oil - GALS, Dollars, BTU
    - Natural Gas - THERMS, Dollars, BTU
    - Propane - GALS, Dollars, BTU
    - Other - QTY, Dollars, BTU
  - o Energy Consumption by Systems.
4. Historical Energy Consumption.
5. Production Profile and Trends.
6. Energy Conservation Analysis.
  - o ECOs Investigated.
  - o ECOs Recommended.
  - o ECOs Rejected. (Provide economics or reasons)
  - o ECIP/ECAM Projects Developed. (Provide list)\*
  - o Non-ECIP/ECAM Projects Developed. (Provide list)\*
  - o Operational or Policy Change Recommendations.

\* Include the following data from the life cycle cost analysis summary sheet: the cost (construction plus SIOH), the annual energy savings (type and amount), the annual dollar savings, the SIR, the simple payback period and the analysis date. For all programmed projects also include the year in which it is programmed and the programmed year cost.
7. Energy and Cost Savings.

- o Total Potential Energy and Cost Savings.
- o Percentage of Energy Conserved.
- o Energy Use and Cost Before and After the Energy Conservation Opportunities are Implemented based on Projected Workloads.

8. Energy Plan.

- o Project Breakouts with Total Cost and SIR.
- o Schedule of Energy Conservation Project Implementation

ANNEX D

DETAIL SCOPE OF WORK  
ENERGY SURVEYS OF ARMY INDUSTRIAL FACILITIES  
ENERGY ENGINEERING ANALYSIS PROGRAM

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## AREAS/BUILDINGS TO BE AUDITED

Shops and  
Maintenance: 12, 13, 14, 19, 33, 37, 42, 57, 320, 370,  
350, 422, 424, 426, 431, 433, 436

### Warehouses:

Conveyor System: 2, 4, 5, 6, 7, 8, 9

Dehumidified,  
Unheated: 31, 32, 34, 41, 44, 47, 52, 53, 55, 56

Dehumidified,  
Heated: 33, 42, 43

Central Heating  
Plants: 2, 3, 8, 12, 225, 349, 423, 683

### SPECIFIC ECOS

1. Reduce energy loss due to compressed air leaks (Building 350).
2. Reduce energy loss at steam clean racks (Buildings 37 and 351)
3. Reduce heat loss from dip tanks (Buildings 37, 57, 350 and 370).
4. Heat recovery at paint spray booths (Buildings 37, 57, 320, 350 and 370).
5. Individual building EMCS (370 and other energy intensive process buildings).
6. Reduce make-up at boiler (Building 349)
7. Reduce boiler auxiliaries energy use (Building 349)

# ECOS TO BE UPDATED

<u>Project Number</u>	<u>Description</u>
G-N	Warehouse Door Seals, Building Numbers 2 and 4
D	Combination Project: Exhaust Heat Recovery, Buildings 37 and 350; Engine Test Cell Heat Recovery, Building 37
E	Vapor Barrier for Dehum. Warehouses 11, 18, 31, 32, 34, 41, 44, 47, 52, 53, 55, 56
G	Exhaust Heat Recovery Building, 350 North End Dip Tanks, All Dip Tank
H	Baghouse 350 Insulation and Air Return
I	Supply/Exhaust Air Heat, Building 350 Paint Booths Numbers 59 and 60
G-E	Exhaust Heat Recovery, Building Number 1, Paint Booth, North End of Building
G-F	Exhaust Heat Recovery, Building Number 14, Paint Booth, East Side of Building
G-G	Exhaust Heat Recovery, Building Number 37, Mid-Building Paint Booth-LEAD 468
G-P	Warehouse Plastic-Strip Doors (Curtain Type), Building Numbers 2 and 4, Fast Moving Doors Air Curtains
G-U	Storm Windows, Building Number 3
G-V	Warehouse Dock Seals, Building Number 2
J	Exhaust Heat Recovery, Building 350 South End-Medium Sized Paint Booths
N	Window and Wall Insulation, 400 Series Buildings
R	Replacement of Existing Buildings 31, 32, 33, 34, 41, 42, 43 and 44 Fluorescent and Mercury Vapor General Area Lighting with High Pressure Sodium Vapor Lighting

ECOS TO BE UPDATED  
(Continued)

<u>Project Number</u>	<u>Description</u>
G-I	Exhaust Heat Recovery, Building Number 350, South End-Dip Tank
G-J	Steam Supply, Building Number 320

## SCHEDULE OF ACTIVITIES

<u>Activity</u>	<u>Calendar Days (NTP Plus)</u>
NTP	0
Interim Submittal	235
Interim Review Conference	285
Prefinal Submittal	325
Prefinal Review Conference	365
Prefinal (Corrected)/Final Submittal	395



# SUBMITTAL DISTRIBUTION LIST

Address	Interim 60%	Prefinal 90%	Final 100%
Commander U.S. Army Engineer Division, North Atlantic ATTN: CENAD-EN-MM 90 Church Street New York, NY 10007	2 cys	2 cys	1 cy
Commander Office of Chief of Engineers ATTN: CEEC-EE (McCarty) Pulaski Building Washington, DC 20314	Executive Summary Only	1 cy	1 cy
Commander U.S. Army Engineer District, Norfolk ATTN: CENAO-EN-MP (Wilkins) 803 Front Street Norfolk, VA 23510	3 cys	3 cys	2 cys
Army Energy Office ATTN: DALO-LEP (Keath) New Cumberland Army Depot New Cumberland, PA 17070	Executive Summary Only	1 cy	1 cy
Commander Letterkenny Army Depot ATTN: SDSLE-EM (D. Faith) Building 663 Chambersburg, PA 17201-4150	<u>2 cys</u>	<u>2 cys</u>	<u>1 cy</u>
	7 cys	9 cys	6 cys

## GOVERNMENT FURNISHED CRITERIA

1. Building information schedule (manual).
2. Production equipment schedule.
3. Utility procurement records (including reimburseable).
4. Facilities engineering technical data support.
5. Equipment modernization/acquisition plan.
6. Basic utility systems information maps.
7. Equipment layout and utilization records.
8. Final reports of previously completed studies performed under the Energy Engineering Analysis Program (EEAP). Only portions pertaining to the industrial facilities, if any, need to be made available.
9. Latest copies of any other energy studies performed since the previous EEAP study. Only portions pertaining to the industrial facilities, if any, need to be made available.
10. Energy Resources Management Plan.
11. ETLs 1110-3-282, Energy Conservation; 1110-3-318, Procedures for Programming Energy Monitoring and Control Systems (EMCS) Funded Through the MCA Program; 1110-3-332, Economic Studies; and 1110-3-354, Direct Digital Control of Heating, Ventilation and Air Conditioning (HVAC) Systems.
12. Architectural and engineering instructions.
13. Energy Conservation Investment Program (ECIP) Guidance, dated 25 April 1988 and revision dated 15 June 1989.
14. Information on Existing EMCS Studies, Designs, Construction Contracts, or Operating Systems.
15. TM 5-785, Engineering Weather Data; TM 5-800-2, General Criteria Preparation of Cost Estimation; TM 5-800-3, Project Development Brochure; and TM 5-815-2, Energy Monitoring and Control Systems (EMCS).
16. AR 415-15, Military Construction Army (MCA) Program Development; AR 415-17, Cost Estimating for Military Programming; AR 415-20, Construction, Project Development and Design Approval; AR 415-28, Department of the Army Facility Classes and Construction Categories; AR 415-35, Construction, Minor

Construction; AR 420-10, General Provisions, Organization, Functions and Personnel; AR 11-27, Army Energy Program; and AR 5-4, Change Number 1, Department of the Army Productivity Improvement Program.

17. HNDSP-84-076-ED-ME, Preliminary Survey and Feasibility Study for Energy Monitoring and Control Systems.

18. NCEL CR 82.030, Standardized EMCS Energy Savings Calculations. (Only if needed for this study.)

19. HNDSP88-207-ED-ME, HNDSP88-208-ED-ME, HNDSP88-209-ED-ME and HNDSP88-210-ED-ME, EMCS Cost Estimating Guides.

20. The latest applicable Engineer Improvement Recommendation System (EIRS) bulletin.

21. An example of a correctly completed programming document for an ECIP/ECAM project.

22. Production data.

23. EEAP, RS&H.

24. Boiler Study, Larson.

25. EMCS Study, BKA.

26. Natural Gas Conversion Study, People's Gas.

27. Paint Booth Heat Recovery, BKA.

## SPECIAL REQUIREMENTS AND INFORMATION

1. Point of contact at Letterkenny Army Depot and liaison for all work required under this contract is:

Jeff Hager  
Letterkenny Army Depot  
ATTN: SDSLE-EME  
Building 663  
Chambersburg, PA  
Phone: (717) 267-8005

2. The fiscal year to which all ECIP projects should be estimated to and programming or implementation documents prepared for is FY 93. Depending on project packaging, the Installation Commander may determine different program years for the final report. Remaining projects shall be escalated to a FY TBD.

3. A computer program titled Life Cycle Costing in Design (LCCID) is available from the BLAST Support Office in Urbana, Illinois for a nominal fee. The computer program can be used for performing the economic calculations for ECIP and non-ECIP ECOs. The AE is encouraged to obtain this computer program. The BLAST Support Office can be contacted at 144 Mechanical Engineering Building, 1206 West Green Street, Urbana, Illinois 61801. The telephone number is (217) 333-3977. AE shall indicate in writing what program will be used.

4. Consolidated review comments will be provided to AE by Project Manager about 14 days prior to review conferences. AE will review each comment and provide consolidated proposed responses to Project Manager 48 hours prior to conference.

5. AE will provide cover letter with all submittals noting a review is required and that a Review Conference is scheduled approximately 45 days hence. Letter will also inform recipients of letter to follow from Norfolk District COE setting exact conference date.

6. Acceptable programs for computer modeling of building energy systems are:

- a. BLAST\*
- b. DOE 2.1B\*
- c. Carrier E20 or HAP\*\*
- d. TRACE\*\*

\*Very accurate, but requires a lot of time for input; therefore, rather expensive for straightforward projects.

\*\*Adequate for load determination, equipment selection, and energy performance for most projects.

**APPENDIX B**

**BACKUP DATA AND CALCULATIONS**

APPENDIX B  
BACKUP DATA, CALCULATIONS AND COST ESTIMATES

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**ENERGY PRICES, BASIC ASSUMPTIONS AND ECONOMIC PARAMETERS**



## ENERGY PRICES, BASIC ASSUMPTIONS AND ECONOMIC PARAMETERS

### Energy Prices (FY 91):

Purchased Electricity:	3,413 Btu/kwh, \$10.94/MBtu, \$0.0373/kwh (avg.)
Energy charge:	\$6.53/MBtu, \$0.0222/kwh
Demand charge:	\$6.59/kw/Mo
Source:	1/91 Electric bill
*Fuel Oil No. 2:	138,690 Btu/gallon, \$7.43/MBtu, \$1.03/gallon
*Fuel Oil Nos 5 & 6:	149,690 Btu/gal, \$6.61/MBtu, \$0.99/gallon
Source:	LEAD memo, 15 Oct. 1990

### Boiler Data: (Source: LEAD Mechanical Engineering Department)

Boiler efficiency	86%
Make-up flow	30% (avg.)
temp	60°F (avg.)
Condensate flow	70% (avg.)
temp	110°F (avg.)
Boiler system	
Efficiency	80%

### Building Temperature Setpoints:

Winter	68°F
Summer	78°F

### Basis for Cost Estimates:

<u>Adjustment</u>	<u>Labor</u>	<u>Material</u>	<u>Comments</u>
Sales Tax	NA	6.5	Includes state and local
FICA/Insurance	20.0%	NA	--
Overhead	15.0%		--
Profit	10.0%		--
Performance Bond	1.0%		--
Contingency	5.0%		New construction
	7.5%		Modernization
	10.0%		Renovation work
SIOH	5.5%		Automatically included in LCCID
Design Fees	6.0%		Automatically included in LCCID

All costs are adjusted to January 1991.

\*On October 1, 1991, the price LEAD pays for fuel oil decreased per their annual contract. All ECOs were recalculated except those that were non-qualifying for any funding (SIR < 1.0 or payback greater than 25 years) using the FY 91 rates.

### FY 92 Prices:

Fuel Oil No. 2:	\$4.98/MBtu, \$0.69/gallon
Fuel Oil Nos. 5 and 6:	\$4.41/MBtu, \$0.66/gallon

Jeff Hagan

ROUTINE

\*\*\*\*\*  
 U N C L A S S I F I E D  
 \*\*\*\*\*

TOR=261 2059 TOD=261 205938 MSG NBR=0AAB-DOF308

ACTION: SDSLE TP ASQNC-DL

INFO: SDSLE

RTTUZYUW RUEMANI6442 2612055-UUUU--RUEPABA.  
 ZNR UUUUU

R 181500Z SEP 91

FM CDR USAGMPA NEW CUMBERLAND PA //STRGP-FI//

TO AIG 8823

AIG 8824

AIG 7305

INFO RUEADWD/HQDA WASHDC //OALD-TSE//

RUKGNLA/CDR DFSC CAMERON STA VA //DFSC-R//

RUCIFRA/CDR TROSCOM STL MD //ANCPH-PWL//

ZEN/CDR LEA NCAD PA //LDEA-PL//

BT

UNCLAS

SUBJECT: BULK PETROLEUM STANDARD PRICES

A. DFSC MSG 111700Z SEP 91 (U) (NOTAL)

1. THE FOLLOWING STANDARD PRICES ARE PROVIDED BY PRODUCT CODE FOR  
 DFSC MAJOR PETROLEUM PRODUCTS AND ARE EFFECTIVE 01 OCT 91.

PRODUCT CODE	UNIT OF ISSUE	STANDARD PRICE
* MUR Gasoline	GALLON 913000/487103	.82
MUP	GALLON	.84
DF1	GALLON	.89
* DF2 #2 Diesel Fuel	GALLON 914000/2865294	.89

PAGE 02 RUEMANI6442 UNCLAS

KSN	GALLON	.69
FS1	GALLON	.89
* FS2 #2 Burner	GALLON 914000/2474365	.69
FS4	GALLON	.66
* FS5 #5 Burner	GALLON 914001/0584431	.66
* FS6 #6 Burner	GALLON 914000/2474354	.66
JP4	GALLON	.70
JP5	GALLON	.71
JP8	GALLON	.70
130	GALLON	1.31

2. DFSC PRICE BULLETIN WILL BE PROVIDED AT A LATER DATE.

3. PER REF A THE OFFICE OF SECRETARY OF DEFENSE HAS INDICATED THAT A  
 SEPARATE STANDARD PRICE FOR INTO-PLANE DELIVERIES MAY BE ESTABLISHED.

ROUTINE

\*\*\*\*\*  
 U N C L A S S I F I E D  
 \*\*\*\*\*

SDSLE-EME

15 Oct 90

MEMORANDUM FOR See Distribution

SUBJECT: Fuel Prices

	FY88	FY89	FY90	FY91	
#FS2	.82	.65	.65	1.03	Contracted Per year Thru Common Station
#5	.70	.55	.55	.99	
#6	.70	.55	.55	.99	
MVS (mogas)	.84	.69	.69	1.23	
JP4	.75	.61	.61	1.05	
DF2	.75	.65	.65	1.03	
DF1				1.03	
Propane	<del>1.129</del>	<del>1.129</del>	<del>.749</del>	<del>.749</del>	market Driven
Electric					1.109 Per GAI
Base	.02219	.02145	.02145	.02200	
Demand	6.355	6.0300	6.0300	\$ 6.0120	Per KVA
Average	.0424	.0424	.0424	.0424	

Per Denny Brenize 10357 KWH  
717-267-5406

Jeffrey L. Hager  
JEFFREY L. HAGER  
Energy Program Technician

CF:  
SDSLE-RPA  
SDSLE-ER  
SDSLE-ERW  
SDSLE-EPE  
SDSLE-EME

## Boiler System Efficiency Calculations



SUBJECT Letterkenny Army Depot  
EEAP  
DESIGNER P. Hutchins  
CHECKER \_\_\_\_\_

AEP NO 290-0379-001  
SHEET \_\_\_\_\_ OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

## Boiler System Efficiency Calculations

### Assumptions:

Boiler Eff. = 0.86

Make-up = 10%

Condensate temp. = 130°F

GUARANTEED FUEL-TO-STEAM EFFICIENCIES\*  
MODEL CB FIRETUBE BOILERS  
OPERATING PRESSURE = 10 PSIG

BOILER SIZE (BHP)	FUEL = NATURAL GAS**					FUEL = NO. 2 OIL***				
	25%	50%	75%	100%		25%	50%	75%	100%	
100	82.5	83.5	83.5	83.5		85.5	86.5	86.5	86.5	
125	81.0	82.0	82.0	82.0		84.0	85.0	85.5	85.5	
150	82.0	83.0	83.0	83.0		85.0	86.0	86.5	86.5	
200	82.5	83.5	83.5	83.5		86.0	87.0	87.0	87.0	
250	81.5	82.0	82.0	82.0		85.0	85.5	85.5	85.5	
300	82.0	82.5	82.5	82.5		85.5	86.0	86.0	86.0	
350	82.5	83.0	83.0	83.0		85.5	86.5	86.5	86.5	
400	82.0	83.0	83.0	83.0		85.0	86.0	86.5	86.5	
500	82.5	84.0	84.0	84.0		86.0	87.0	87.5	87.5	
600	83.0	84.0	84.5	84.5		86.0	87.5	87.5	87.5	
700	83.0	84.5	84.5	84.5		86.5	87.5	88.0	88.0	
800	83.5	84.5	84.5	84.5		87.0	88.0	88.0	88.0	

\*Include radiation and convection boiler heat losses to the boiler room.  
\*\*1000 BTU/Cu. ft.; Max. smoke density = Bacharach "0".  
\*\*\*140,000 BTU/Gal.; Max. smoke density = Bacharach "1".  
\*\*\*\*150,000 BTU/Gal.; Max. smoke density = Bacharach "2.3".

NOTE: These efficiencies are attainable and provable - in your boiler room!

BOILER SIZE (BHP)	FUEL = NO. 6 OIL****				
	25%	50%	75%	100%	
100	86.0	87.0	87.0	87.0	
125	84.5	85.5	86.0	86.0	
150	85.5	86.5	87.0	87.0	
200	86.5	87.5	87.5	87.5	
250	85.5	86.0	86.0	86.0	
300	86.0	86.5	86.5	86.5	
350	86.0	87.0	87.0	87.0	
400	85.5	86.5	87.0	87.0	
500	86.5	87.5	88.0	88.0	
600	86.5	88.0	88.0	88.0	
700	87.0	88.0	88.5	88.5	
800	87.5	88.5	88.5	88.5	

Ref: Cleaver Brooks Catalogue

GUARANTEED FUEL-TO-STEAM EFFICIENCIES\*  
MODEL CB FIRETUBE BOILERS  
OPERATING PRESSURE = 125 PSIG

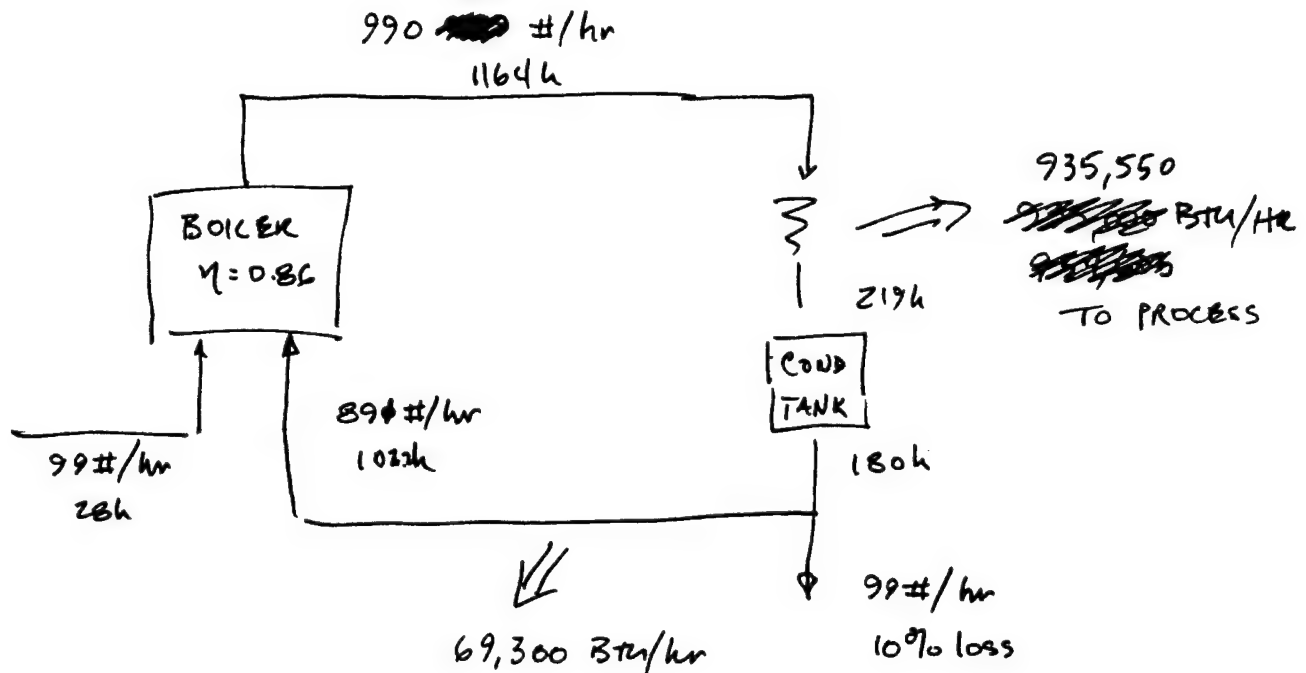
BOILER SIZE (BHP)	FUEL = NATURAL GAS**					FUEL = NO. 2 OIL***				
	25%	50%	75%	100%		25%	50%	75%	100%	
100	78.5	80.5	81.0	81.0		81.5	83.5	84.0	84.0	
125	77.0	79.0	79.5	79.5		80.0	82.0	82.5	83.0	
150	78.0	80.0	80.5	80.5		81.0	83.0	83.5	84.0	
200	79.0	80.5	81.0	81.5		82.0	84.0	84.5	84.5	
250	78.0	79.5	80.0	80.0		81.5	83.0	83.0	83.0	
300	78.5	80.0	80.5	80.5		81.5	83.5	83.5	83.5	
350	78.5	80.5	81.0	81.0		82.0	84.0	84.5	84.5	
400	78.0	80.0	80.5	80.5		81.5	83.5	84.0	84.0	
500	79.0	81.0	81.5	81.5		82.0	84.0	85.0	85.0	
600	79.5	81.0	82.0	82.0		82.5	84.5	85.0	85.5	
700	79.5	81.5	82.0	82.0		82.5	84.5	85.5	85.5	
800	80.0	81.5	82.0	82.0		83.0	85.0	85.5	85.5	

\*Include radiation and convection boiler heat losses to the boiler room.  
\*\*1000 BTU/Cu. ft.; Max. smoke density = Bacharach "0".  
\*\*\*140,000 BTU/Gal.; Max. smoke density = Bacharach "1".  
\*\*\*\*150,000 BTU/Gal.; Max. smoke density = Bacharach "2.3".

NOTE: These efficiencies are attainable and provable - in your boiler room!

BOILER SIZE (BHP)	FUEL = NO. 6 OIL****				
	25%	50%	75%	100%	
100	82.0	84.0	84.5	84.5	
125	80.5	82.5	83.0	83.5	
150	81.5	83.5	84.0	84.5	
200	82.5	84.5	85.0	85.0	
250	82.0	83.5	83.5	83.5	
300	82.0	84.0	84.0	84.0	
350	82.5	84.5	85.0	85.0	
400	82.0	84.0	84.5	84.5	
500	82.5	84.5	85.5	85.5	
600	83.0	85.0	85.5	86.0	
700	83.0	85.0	86.0	86.0	
800	83.5	85.5	86.0	86.0	

FOR A 10 #/hr change in steam flow  
assuming all ~~loss~~ after cond. tank are constant



COND. RTU

ENTHALPY :  $890 (180 - h) = 69,300$   
 $h = 102.2$

FUEL REQD =  $\frac{990 (1164) - 890 (102) - 99 (28)}{0.86}$

=  $\frac{1,230,965}{1,230,965} \text{ Btu/hr}$

$\Delta \text{PROC}$   
 $\Delta \text{FUEL} = \frac{945,000 - 935,550}{1,242,442 - 1,230,965} = 0.82$

This calculation assumes all losses after condensate tank are independent of flow. The actual value lies somewhere between 0.82 and 0.76. Say 0.80 Therefore, a 1 MBtu

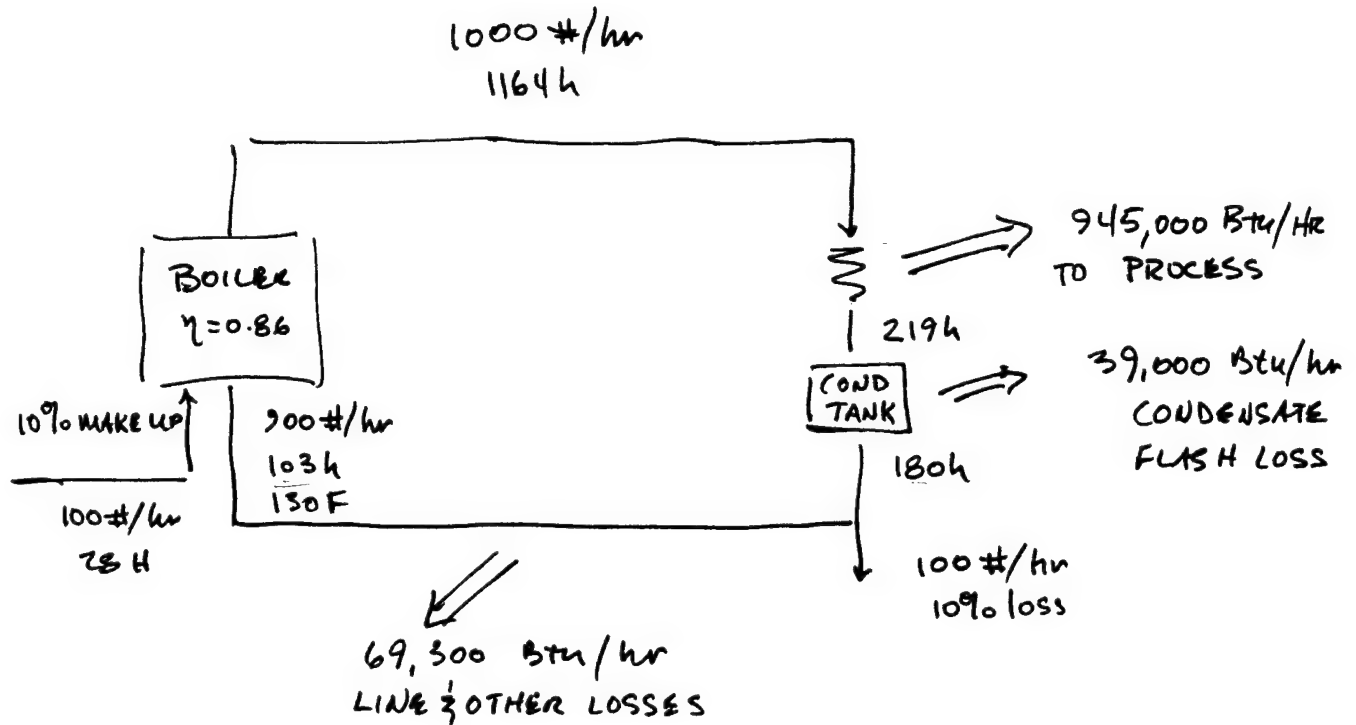
savings in process energy will save 1.25 MBtu's of fuel.



SUBJECT LEAD BOILER/STEAM  
SYSTEM EFFICIENCY  
 DESIGNER JFH  
 CHECKER \_\_\_\_\_

AEP NO 35  
 SHEET \_\_\_\_\_ OF \_\_\_\_\_  
 DATE 5/15/91  
 DATE \_\_\_\_\_

Calculate the fuel requirements for changes in steam flow due to energy savings projects.



$$\text{FUEL REQ'D} = \frac{1000(1164) - 900(103) - 100(28)}{0.86}$$

$$= 1,242,442 \text{ BTU/Hr}$$

$$\frac{\text{PROC}}{\text{FUEL}} = \frac{945,000}{1,242,442} = 0.76$$



Heating Energy Use Per CFM of Exhausted Air

# LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 24

Room or Supply Air Conditions - Winter 68  
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 1  
9 AM - 5 PM 1  
5 PM - 1 AM 1

Operation Days Per Week 5

Temp. Range	Hours of Occurrence			Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
	2-9	10-17	18-1						
70 74	247	237	301	785	-4	1.08	1	0	0
65 69	296	217	278	791	1	1.08	1	1	854
60 64	269	196	236	701	6	1.08	1	6	4,542
55 59	249	191	209	649	11	1.08	1	12	7,710
50 54	221	193	202	616	16	1.08	1	17	10,644
45 49	218	193	206	617	21	1.08	1	23	13,994
40 44	237	236	239	712	26	1.08	1	28	19,993
35 39	289	246	286	821	31	1.08	1	33	27,487
30 34	304	194	258	756	36	1.08	1	39	29,393
25 29	184	106	152	442	41	1.08	1	44	19,572
20 24	124	65	90	279	46	1.08	1	50	13,861
15 19	75	32	57	164	51	1.08	1	55	9,033
10 14	54	13	26	93	56	1.08	1	60	5,625
5 9	18	3	9	30	61	1.08	1	66	1,976
0 4	9	0	2	11	66	1.08	1	71	784
-5 -1	3	0	1	4	71	1.08	1	77	307
-10 -6	1	0	0	1	76	1.08	1	82	82
-15 -11	0	0	0	0	81	1.08	1	87	0
Totals	2798	2122	2552	7472					165,858

Total Operation Hours While Heating  
(and corrected for working days/week) 4776 118,470

Avg outdoor temp while heating (F) 45.0

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 16

Room or Supply Air Conditions - Winter 68  
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 0.375  
9 AM - 5 PM 1  
5 PM - 1 AM 0.625

Operation Days Per Week 5

Temp. Range	Hours of Occurrence			Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
	2-9	10-17	18-1						
70	74	247	237	301	518	-4	1.08	1	0
65	69	296	217	278	502	1	1.08	1	542
60	64	269	196	236	444	6	1.08	1	2,880
55	59	249	191	209	415	11	1.08	1	4,930
50	54	221	193	202	402	16	1.08	1	6,949
45	49	218	193	206	404	21	1.08	1	9,151
40	44	237	236	239	474	26	1.08	1	13,317
35	39	289	246	286	533	31	1.08	1	17,849
30	34	304	194	258	469	36	1.08	1	18,244
25	29	184	106	152	270	41	1.08	1	11,956
20	24	124	65	90	168	46	1.08	1	8,334
15	19	75	32	57	96	51	1.08	1	5,274
10	14	54	13	26	50	56	1.08	1	2,994
5	9	18	3	9	15	61	1.08	1	1,013
0	4	9	0	2	5	66	1.08	1	330
-5	-1	3	0	1	2	71	1.08	1	134
-10	-6	1	0	0	0	76	1.08	1	31
-15	-11	0	0	0	0	81	1.08	1	0
=====									
Totals		2798	2122	2552	4766				103,927

Total Operation Hours While Heating  
(and corrected for working days/week) 3035 74,233

Avg outdoor temp while heating (F) 45.0

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 16

Room or Supply Air Conditions - Winter 65  
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 0.25  
9 AM - 5 PM 1  
5 PM - 1 AM 0.75

Operation Days Per Week 6

Temp. Range	Hours of Occurrence			Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
	2-9	10-17	18-1						
70	74	247	237	301	525	-7	1.08	1	0
65	69	296	217	278	500	-2	1.08	1	0
60	64	269	196	236	440	3	1.08	1	3,426
55	59	249	191	209	410	8	1.08	1	3,542
50	54	221	193	202	400	13	1.08	1	5,612
45	49	218	193	206	402	18	1.08	1	7,815
40	44	237	236	239	475	23	1.08	1	11,787
35	39	289	246	286	533	28	1.08	1	16,110
30	34	304	194	258	464	33	1.08	1	16,519
25	29	184	106	152	266	38	1.08	1	10,917
20	24	124	65	90	164	43	1.08	1	7,593
15	19	75	32	57	94	48	1.08	1	4,847
10	14	54	13	26	46	53	1.08	1	2,633
5	9	18	3	9	14	58	1.08	1	893
0	4	9	0	2	4	63	1.08	1	255
-5	-1	3	0	1	2	68	1.08	1	110
-10	-6	1	0	0	0	73	1.08	1	20
-15	-11	0	0	0	0	78	1.08	1	0

Totals 4735.5 90,080

Total Operation Hours While Heating  
(and corrected for working days/week) 3181 77,211

Avg outdoor temp while heating (F) 42.5

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 8

Room or Supply Air Conditions - Winter 68  
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 0.25  
9 AM - 5 PM 0.75  
5 PM - 1 AM 0

Operation Days Per Week 5

Temp. Range		Hours of Occurrence			Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
		2-9	10-17	18-1						
70	74	247	237	301	240	-4	1.08	1	0	0
65	69	296	217	278	237	1	1.08	1	1	256
60	64	269	196	236	214	6	1.08	1	6	1,388
55	59	249	191	209	206	11	1.08	1	12	2,441
50	54	221	193	202	200	16	1.08	1	17	3,456
45	49	218	193	206	199	21	1.08	1	23	4,519
40	44	237	236	239	236	26	1.08	1	28	6,634
35	39	289	246	286	257	31	1.08	1	33	8,596
30	34	304	194	258	222	36	1.08	1	39	8,612
25	29	184	106	152	126	41	1.08	1	44	5,557
20	24	124	65	90	80	46	1.08	1	50	3,962
15	19	75	32	57	43	51	1.08	1	55	2,355
10	14	54	13	26	23	56	1.08	1	60	1,406
5	9	18	3	9	7	61	1.08	1	66	445
0	4	9	0	2	2	66	1.08	1	71	160
-5	-1	3	0	1	1	71	1.08	1	77	58
-10	-6	1	0	0	0	76	1.08	1	82	21
-15	-11	0	0	0	0	81	1.08	1	87	0

Totals 2798 2122 2552 2291 49,865

Total Operation Hours While Heating  
(and corrected for working days/week) 1465 35,618

Avg outdoor temp while heating (F) 45.0

**Cost Estimates Backup**

SUBJECT BKA MARK UPS

AEP NO \_\_\_\_\_

DESIGNER P. Hutchins

SHEET \_\_\_\_\_ OF \_\_\_\_\_

CHECKER \_\_\_\_\_

DATE 5/16/91

DATE \_\_\_\_\_

Since price estimates from the "Study of Heat Recovery Applications for Paint and Drying Booths" by Brunjoe, Kambic and Assoc. (BKA), 8/87 provided detailed and more recent cost estimates than the LEAD EEAP, by RS&H, '80, the BKA estimates were used. However, the cost mark ups used by BKA had to be modified to be consistent with the Army's current requirements.

	(8/87)		Current Requirements
	<u>BKA</u>		
Sales tax	6 %		6.5 %
Labor Mark up	21 %		20 %
Overhead	10 %	} 1.62	15 %
Profit	10 %		10 %
Design Contingency	10 %		} 10 %
Construction Contingency	5 %		
SIOH	5.5 %		5.5 %
Engineering Design	10 %		6 %
			} 1.56

Ref. BKA Report, Vol. I., p171-186

Since the mark-ups are so close corrections were made only for those projects qualifying for funding, ie. SIR > 1.0 and payback < 10 years.



SUBJECT LEAD LABOR RATES

AEP NO \_\_\_\_\_

DESIGNER P. Hutchins

SHEET \_\_\_\_\_ OF \_\_\_\_\_

DATE 5/29/91

CHECKER \_\_\_\_\_

DATE \_\_\_\_\_

LETTERKENNY LABOR RATES

STEAM/PLUMBING	-	\$16.17/hr
A/C / ELECTRICAL	-	\$16.76/hr



## Building Cost Index history, 1913-1990

How ENR builds the index: 68.38 hours of skilled labor at the 20-city average of bricklayers', carpenters' and structural ironworkers' rates, plus 25 cwt of standard structural steel shapes at the mill price, plus 22.56 cwt (1.128 tons) of portland cement at the 20-city price, plus 1,088 board-ft of 2 x 4 lumber at the 20-city price

Annual average			Monthly index												Annual avg.				
			Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.					
1913	100	1933	148	1953	431	1971	875	877	905	913	933	946	959	970	986	997	1001	1005	948
1914	92	1934	167	1954	448	1972	1011	1016	1022	1027	1039	1047	1053	1057	1067	1070	1082	1090	1048
1915	95	1935	166	1955	469	1973	1102	1114	1123	1135	1140	1138	1137	1144	1150	1156	1155	1158	1138
1916	131	1936	172	1956	491	1974	1156	1154	1155	1177	1177	1199	1233	1240	1238	1246	1239	1240	1206
1917	167	1937	196	1957	509	1975	1242	1265	1265	1269	1287	1307	1317	1320	1333	1351	1349	1354	1306
1918	159	1938	197	1958	525	1976	1362	1370	1379	1391	1398	1416	1425	1455	1467	1476	1479	1484	1425
1919	159	1939	197	1959	548	1977	1489	1499	1504	1506	1507	1521	1539	1554	1567	1587	1604	1607	1545
1920	207	1940	203	1960	559	1978	1609	1617	1620	1621	1652	1663	1696	1705	1720	1721	1732	1734	1674
1921	166	1941	211	1961	568	1979	1740	1740	1750	1749	1753	1809	1829	1849	1860	1890	1901	1909	1819
1922	155	1942	222	1962	580	1980	1895	1894	1915	1899	1888	1916	1929	1971	1976	1976	2000	2017	1941
1923	186	1943	229	1963	594	1981	2015	2016	2014	2064	2076	2080	2106	2131	2154	2151	2181	2178	2087
1924	186	1944	235	1964	612	1982	2184	2198	2192	2197	2199	2225	2258	2259	2183	2262	2268	2297	2225
1925	183	1945	239	1965	627	1983	2311	2348	2352	2347	2351	2388	2414	2426	2430	2416	2419	2406	2384
1926	185	1946	262	1966	650	1984	2402	2407	2412	2422	2419	2417	2418	2428	2430	2424	2421	2408	2417
1927	186	1947	313	1967	676	1985	2410	2414	2406	2405	2411	2429	2448	2442	2441	2441	2446	2439	2428
1928	188	1948	345	1968	721	1986	2440	2446	2447	2458	2479	2493	2499	2498	2504	2511	2511	2511	2483
1929	191	1949	352	1969	790	1987	2515	2510	2518	2523	2524	2525	2538	2557	2564	2569	2564	2589	2541
1930	185	1950	375	1970	836	1988	2574	2576	2586	2591	2592	2595	2598	2611	2612	2612	2616	2617	2586
1931	168	1951	401			1989	2619	2613	2616	2619	2621	2626	2631	2639	2668	2672	2674	2679	2649
1932	131	1952	416			1990	2673	2675	2685	2684	2697	2725	2725	2729	2729	2730			

Base: 1913 = 100

Base: 1913=100

FEB. 91

$$\frac{1/91}{7/80} \Rightarrow \frac{2716}{1950} = 1.39$$

## Construction Cost Index history, 1906-1990

How ENR builds the index: 200 hours of common labor at the 20-city average of common labor rates, plus 25 cwt of standard structural steel shapes at the mill price, plus 22.56 cwt (1.128 tons) of portland cement at the 20-city price, plus 1,088 board-ft of 2 x 4 lumber at the 20-city price

Annual average					Monthly index												Annual avg.		
					Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.			
1906	95	1928	207	1950	510	1971	1465	1467	1496	1513	1551	1589	1618	1629	1654	1657	1665	1672	1581
1907	101	1929	207	1951	543	1972	1686	1691	1697	1707	1735	1761	1772	1777	1786	1794	1808	1816	1753
1908	97	1930	203	1952	569	1973	1838	1850	1859	1874	1880	1896	1901	1902	1929	1933	1935	1939	1895
1909	91	1931	181	1953	600	1974	1940	1940	1940	1961	1961	1993	2040	2076	2089	2100	2094	2101	2029
1910	96	1932	157	1954	628	1975	2103	2128	2128	2135	2164	2205	2248	2274	2275	2293	2292	2297	2212
1911	93	1933	170	1955	660	1976	2305	2314	2322	2327	2357	2410	2414	2445	2465	2478	2486	2490	2401
1912	91	1934	198	1956	692	1977	2494	2505	2513	2514	2515	2541	2579	2611	2644	2675	2659	2660	2576
1913	100	1935	196	1957	724	1978	2672	2681	2693	2698	2733	2753	2821	2829	2851	2851	2861	2869	2776
1914	89	1936	206	1958	759	1979	2872	2877	2886	2886	2889	2984	3052	3071	3120	3122	3131	3140	3003
1915	93	1937	235	1959	797	1980	3132	3134	3159	3143	3139	3198	3260	3304	3319	3327	3355	3376	3237
1916	130	1938	236	1960	824	1981	3372	3373	3384	3450	3471	3496	3548	3616	3657	3660	3697	3695	3535
1917	181	1939	236	1961	847	1982	3704	3728	3721	3731	3734	3815	3899	3899	3902	3901	3917	3950	3825
1918	189	1940	242	1962	872	1983	3960	4001	4006	4001	4003	4073	4108	4132	4142	4127	4133	4110	4069
1919	198	1941	258	1963	901	1984	4109	4113	4118	4132	4142	4161	4168	4189	4176	4181	4158	4144	4149
1920	251	1942	278	1964	936	1985	4145	4153	4151	4150	4171	4201	4220	4230	4229	4228	4231	4228	4186
1921	202	1943	290	1965	971	1986	4218	4230	4231	4242	4275	4303	4332	4334	4335	4344	4342	4351	4285
1922	174	1944	299	1966	1019	1987	4354	4352	4359	4363	4369	4387	4404	4443	4456	4459	4453	4478	4409
1923	214	1945	308	1967	1074	1988	4470	4473	4484	4489	4493	4525	4532	4542	4535	4555	4567	4568	4519
1924	215	1946	346	1968	1155	1989	4574	4567	4568	4571	4572	4593	4596	4606	4647	4646	4655	4679	4608
1925	207	1947	413	1969	1269	1990	4673	4674	4701	4703	4697	4735	4735	4755	4755	4755			
1926	208	1948	461	1970	1381														
1927	206	1949	477																

Base: 1913=100

FEB 91 4773

**ENERGY PRODUCTION DATA, DATA AND ANALYSIS**

LETTERKENNY ARMY DEPOT  
FUEL CONSUMPTION REPORT  
IN GALLONS

BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
** BOILER LOCATION: BUILDING 1		SERVES BUILDINGS: 1, 2												FUEL TYPE: 5
1	FY87	4545	2640	728	2810	3401	6278	10899	6000	17985	2112	3989	8052	69439
1	FY88	0	21786	9197	4575	16052	4647	10351	225	2472	0	0	0	69305
1	FY89	294	5623	9885	2697	16802	3138	10534	706	91	1321	1027	4165	56283
1	FY90	6864	10838	851	8832	15574	2377	-1	4007	0	1386	378	0	51106
** BOILER LOCATION: BUILDING 2		SERVES BUILDINGS: 4, 7												FUEL TYPE: 2
2	FY87	896	732	4206	9777	9384	8246	2710	2636	3836	3636	2916	190	49165
2	FY88	8018	943	10711	12793	27167	15963	12033	8226	4936	21796	4113	1233	127932
2	FY89	2112	6053	602	2783	11941	1044	10607	1107	0	0	0	0	36249
2	FY90	5131	14811	17118	20647	4276	4882	2137	0	0	1220	4410	0	74632
** BOILER LOCATION: BUILDING 3		SERVES BUILDINGS: 3, 5												FUEL TYPE: 5
3	FY87	756	6275	908	6695	15	1361	1931	2617	4275	8198	15139	5951	54121
3	FY88	3368	6455	13284	11511	3649	7043	4445	6164	392	0	0	0	56311
3	FY89	0	12449	4999	4672	17211	5886	2140	1230	0	179	228	1266	50260
3	FY90	3787	1852	2154	7188	11293	4493	-1	0	0	0	0	0	30766
** BOILER LOCATION: BUILDING 8		SERVES BUILDINGS: 6, 8, 9												FUEL TYPE: 2
8	FY87	1088	7035	13054	16931	13780	9278	9475	163	0	0	123	551	71478
8	FY88	0	8435	10865	1249	24192	0	4246	77	0	3544	3534	7465	63607
8	FY89	9612	4042	2798	4808	446	4719	336	522	0	0	0	0	27283
8	FY90	3614	8846	9613	11906	7665	1679	3123	0	0	0	0	0	46446
** BOILER LOCATION: BUILDING 10		SERVES BUILDINGS: 10												FUEL TYPE: 2
10	FY87	254	66	77	96	129	65	106	83	0	356	250	0	1482
10	FY88	530	1177	4509	3631	2993	3240	637	619	0	206	121	58	17721
10	FY89	103	1982	3918	4290	2413	2534	910	215	0	300	2703	500	19868
10	FY90	0	1315	4433	4942	2225	789	0	0	0	0	0	0	13704
** BOILER LOCATION: BUILDING 12		SERVES BUILDINGS: 12, 13, 14												FUEL TYPE: 5
12	FY87	1794	1732	833	2938	4103	2987	961	31	62	4	92	184	15721
12	FY88	369	2414	3949	4405	3537	2370	1547	131	0	0	0	0	18722
12	FY89	800	2507	4263	2818	3824	2596	789	269	0	0	0	0	17866
12	FY90	675	3428	2929	1432	2430	3067	521	0	0	0	0	0	14482
** BOILER LOCATION: BUILDING 37HP		SERVES BUILDINGS: 37												FUEL TYPE: 2
37HP	FY87	3506	3583	2147	6008	4366	3582	3763	4823	1153	5113	3037	5424	46505
37HP	FY88	4633	4840	5453	6893	6583	7643	2435	5611	6266	7803	2280	6856	67296
37HP	FY89	2625	5712	6551	6816	8100	5837	5824	1110	1108	3660	6957	3379	57679
37HP	FY90	5486	9712	5367	4934	5666	9263	8553	1012	0	0	0	0	49993
** BOILER LOCATION: BUILDING 37N		SERVES BUILDINGS: 37												FUEL TYPE: 5
37N	FY87	101	1477	4097	4079	4300	3586	1307	155	0	0	40	40	19182
37N	FY88	731	3099	1571	2750	10474	4706	4820	156	312	624	1248	960	31451
37N	FY89	1920	1951	266	3412	4256	3531	1084	123	0	0	0	0	16543
37N	FY90	1553	5008	7038	1798	2996	5695	1079	0	0	0	0	0	25167

LETTERKENNY ARMY DEPOT  
FUEL CONSUMPTION REPORT  
IN GALLONS

BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
** BOILER LOCATION: BUILDING 37W		SERVES BUILDINGS: 37												FUEL TYPE: 5
37W	FY87	809	4259	4881	5170	6669	3235	4434	587	0	0	21	314	30379
37W	FY88	2263	5063	7661	7255	7621	11432	50	20	0	0	0	952	42317
37W	FY89	3246	1966	9258	5384	5473	11458	1340	417	0	0	0	0	38542
37W	FY90	3002	5780	11973	5877	6659	498	85	92	0	0	0	0	33966
** BOILER LOCATION: BUILDING 57		SERVES BUILDINGS: 57												FUEL TYPE: 2
57	FY87	157	3620	1797	149	1696	1005	3843	4179	3144	5374	873	1612	27449
57	FY88	62	340	1081	301	10509	102	113	120	120	120	240	320	13428
57	FY89	4121	2677	3946	2854	4992	713	779	984	155	265	0	99	21585
57	FY90	2388	4519	1715	830	2377	4442	-1	-1	0	0	0	0	16269
** BOILER LOCATION: BUILDING 57		SERVES BUILDINGS: 57												FUEL TYPE: 5
57	FY87	5215	2210	14650	9417	3805	7076	3543	2089	0	0	137	0	48142
57	FY88	279	1192	3890	11168	4239	1077	8406	6077	12160	2522	5044	6322	62376
57	FY89	6821	2588	3172	2675	0	298	8856	7436	0	0	0	0	31846
** BOILER LOCATION: BUILDING 57 UG		SERVES BUILDINGS: 57												FUEL TYPE: 5
57 UG	FY90	4326	7258	5198	5689	8636	5797	4962	129	0	0	0	0	41995
BOILER LOCATION: BUILDING 320		SERVES BUILDINGS: 320												FUEL TYPE: 2
320	FY87	7628	13057	17319	13964	17411	9351	13923	4526	63	0	0	0	97242
320	FY88	7610	13190	17159	11396	20536	2500	9700	7474	0	19478	1122	2244	112409
320	FY89	16388	3739	6956	14056	13696	11761	5482	4600	0	0	0	317	76995
320	FY90	6844	8494	3607	21073	6236	10041	2415	4585	0	0	0	0	63295
** BOILER LOCATION: BUILDING 349		SERVES BUILDINGS: 349, 350, 351, 370												FUEL TYPE: 6
349	FY87	18477	11407	109053	93915	87451	193015	163756	33396	8355	10026	107039	94669	930559
349	FY88	78372	99354	119664	90881	115473	194266	76869	24404	62407	8469	54091	48076	972326
349	FY89	38176	107521	93424	127421	100793	3602	115759	46672	111864	43945	28152	26128	843457
349	FY90	50101	63613	92937	131077	115055	141479	33392	432180	33138	28350	8274	21252	1150848
** BOILER LOCATION: BUILDING 349		SERVES BUILDINGS: 349, 350, 351, 370												FUEL TYPE: FOR
349	FY90	0	0	0	0	0	0	0	0	0	0	24654	0	24654
** BOILER LOCATION: BUILDING 423		SERVES BUILDINGS: 421, 422, 423, 424, 426, 428, 431, 436, 437, 438												FUEL TYPE: 5
423	FY87	2359	11372	18484	20266	19124	14146	3046	1040	0	0	207	0	90044
423	FY88	7292	10570	31056	22230	20582	9972	19597	731	0	0	0	0	122030
423	FY89	7536	1242	29500	1570	14036	20925	6723	3274	0	0	0	0	84806
423	FY90	4708	13192	25420	22624	7019	21319	8332	996	0	0	0	0	103610
** BOILER LOCATION: BUILDING 1466		SERVES BUILDINGS:												FUEL TYPE: 2
1466	FY87	0	251	1457	1539	2421	1381	441	136	0	0	0	0	7626
1466	FY88	195	1056	1428	3740	3351	1431	0	658	0	0	0	0	11859
1466	FY89	522	1390	2309	1754	2253	1355	984	0	0	0	0	425	10992
1466	FY90	1097	0	3836	2064	1313	750	278	0	0	0	0	0	9338

LETTERKENNY ARMY DEPOT  
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BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
** BOILER LOCATION: BUILDING 2360		SERVES BUILDINGS: 2354, 2357, 2383, 2364, 2360												FUEL TYPE: 2
2360	FY87	3196	3183	1423	2097	5453	656	329	924	0	0	1088	901	19250
2360	FY88	0	0	676	1168	2945	2080	850	0	0	0	0	1961	9680
2360	FY89	2215	3212	2423	1310	738	484	0	637	0	1961	298	911	14189
2360	FY90	298	2330	689	1352	2623	4754	78	510	0	0	0	0	12634
** BOILER LOCATION: BUILDING 2360		SERVES BUILDINGS: 2354, 2357, 2383, 2364, 2360												FUEL TYPE: 5
2360	FY87	5626	9701	11783	767	3516	2770	2616	293	0	0	0	392	37464
2360	FY88	1511	278	18255	15537	6497	11601	6980	6739	0	0	0	0	67398
2360	FY89	2243	393	11625	7361	12619	21720	8934	3709	2641	0	300	298	71843
2360	FY90	911	4626	15765	10602	11223	6420	1930	0	0	0	0	0	51477
** BOILER LOCATION: BUILDING 2384		SERVES BUILDINGS:												FUEL TYPE: 2
2384	FY87	0	234	237	20	210	285	209	0	0	101	0	0	1296
2384	FY88	0	290	192	241	206	68	0	262	0	0	0	0	1259
2384	FY89	0	237	144	248	102	243	0	254	0	0	0	0	1228
2384	FY90	0	0	0	0	0	0	0	0	0	0	0	0	0
** BOILER LOCATION: BUILDING 2702		SERVES BUILDINGS:												FUEL TYPE: 2
2702	FY87	113	280	115	323	327	124	203	0	0	0	0	0	1485
2702	FY88	0	290	216	236	464	0	0	0	0	246	0	0	1452
2702	FY89	0	267	290	247	277	397	100	0	0	0	0	320	1898
2702	FY90	0	276	261	440	359	0	265	0	0	0	0	0	1601
** BOILER LOCATION: BUILDING 2755		SERVES BUILDINGS:												FUEL TYPE: 2
2755	FY87	0	333	0	0	687	2148	616	0	0	0	0	0	3784
2755	FY88	0	228	1170	2248	1342	0	1640	298	0	0	0	0	6926
2755	FY89	0	1572	1335	1713	1285	1060	1174	247	0	0	0	0	8386
2755	FY90	0	451	1407	850	1190	395	0	0	0	0	0	0	4293
** BOILER LOCATION: BUILDING 3170		SERVES BUILDINGS:												FUEL TYPE: 2
3170	FY87	0	112	30	180	115	25	0	0	0	0	36	0	498
3170	FY88	0	32	17	55	0	20	0	0	33	0	0	0	157
3170	FY89	0	59	48	39	18	0	0	0	0	0	0	66	230
3170	FY90	0	0	31	59	47	0	0	0	0	0	0	0	137
** BOILER LOCATION: BUILDING 3311		SERVES BUILDINGS:												FUEL TYPE: 2
3311	FY87	0	203	295	434	666	457	104	0	0	0	0	0	2159
3311	FY88	153	392	282	1157	512	754	0	287	0	0	0	0	3537
3311	FY89	0	535	552	640	642	329	208	206	0	0	0	0	3112
3311	FY90	0	284	542	520	289	344	0	0	0	0	0	0	1979
** BOILER LOCATION: BUILDING 3321		SERVES BUILDINGS:												FUEL TYPE: 2
3321	FY87	0	94	395	0	448	438	305	0	0	0	74	0	1754
3321	FY88	244	464	201	662	357	700	0	511	0	0	0	0	3139
3321	FY89	0	654	413	695	655	379	335	495	0	0	0	0	3626
3321	FY90	0	0	400	104	281	0	400	0	0	0	0	0	1185

LETTERKENNY ARMY DEPOT  
FUEL CONSUMPTION REPORT  
IN GALLONS

BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
** BOILER LOCATION: BUILDING 3387		SERVES BUILDINGS:												FUEL TYPE: 2
3387	FY87	0	200	0	459	142	174	157	0	0	0	0	0	1132
3387	FY88	0	204	164	161	300	235	0	114	0	0	0	0	1178
3387	FY89	0	0	177	258	195	212	0	234	0	0	0	0	1076
3387	FY90	0	142	264	241	0	262	0	0	0	0	0	0	909
** BOILER LOCATION: BUILDING 3626		SERVES BUILDINGS:												FUEL TYPE: 2
3626	FY87	0	444	1232	839	648	2336	536	301	0	0	0	0	6336
3626	FY88	0	1255	769	1554	1588	899	0	943	0	0	0	0	7008
3626	FY89	0	1310	981	1267	1488	852	1086	0	0	0	0	0	6984
3626	FY90	0	1153	1340	0	1333	0	1952	0	0	0	0	0	5778
** BOILER LOCATION: BUILDING 3700		SERVES BUILDINGS:												FUEL TYPE: 2
3700	FY87	0	1150	300	1052	760	1517	325	0	0	0	0	0	5104
3700	FY88	197	1125	501	1096	860	0	1118	0	0	183	0	0	5080
3700	FY89	0	77	0	2290	1369	703	814	608	0	0	0	0	5861
3700	FY90	0	670	1514	951	520	1454	0	0	0	0	0	0	5109
** BOILER LOCATION: BUILDING 3751		SERVES BUILDINGS:												FUEL TYPE: 2
3751	FY87	178	935	352	2136	1283	1370	592	0	382	0	0	0	7228
3751	FY88	0	205	0	0	0	0	0	0	0	0	0	0	205
3751	FY89	0	0	627	253	940	1047	525	590	0	0	0	1725	5707
3751	FY90	0	3469	2763	1691	1025	2171	0	0	0	0	0	0	11119
** BOILER LOCATION: BUILDING 3810		SERVES BUILDINGS:												FUEL TYPE: 2
3810	FY87	0	1687	2205	0	7163	3453	1051	0	0	0	0	0	15559
3810	FY88	907	1017	1910	4405	11657	2531	1786	1538	0	0	0	0	25751
3810	FY89	0	1598	2290	1328	2233	2427	2398	0	0	0	0	0	12274
3810	FY90	2276	0	4636	4611	1504	0	0	0	0	0	0	0	13027
** BOILER LOCATION: BUILDING 3812		SERVES BUILDINGS:												FUEL TYPE: 2
3812	FY87	0	441	147	855	682	300	412	0	0	0	0	0	2837
3812	FY88	157	127	160	642	513	319	354	171	0	0	0	0	2443
3812	FY89	0	316	287	408	336	343	619	0	0	0	0	0	2309
3812	FY90	532	0	512	652	420	0	0	0	0	0	0	0	2116
** BOILER LOCATION: BUILDING 4341		SERVES BUILDINGS:												FUEL TYPE: 2
4341	FY87	0	203	221	626	253	471	125	0	125	0	0	0	2024
4341	FY88	0	385	269	615	353	198	0	331	0	0	0	46	2197
4341	FY89	0	192	307	630	241	347	146	241	0	0	0	0	2104
4341	FY90	0	277	462	0	701	0	100	0	0	0	0	0	1540
** BOILER LOCATION: BUILDING 4756		SERVES BUILDINGS:												FUEL TYPE: 2
4756	FY87	0	608	1202	0	4583	1715	1126	0	0	0	0	0	9234
4756	FY88	407	1422	1903	2241	3665	2668	0	1872	0	0	0	0	14178
4756	FY89	0	2051	2016	1270	2525	2005	890	875	0	0	0	0	11632
4756	FY90	0	1104	2019	2946	1507	2000	0	0	0	0	0	0	9576

LETTERKENNY ARMY DEPOT  
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BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
** BOILER LOCATION: BUILDING 5249		SERVES BUILDINGS:												FUEL TYPE: 2
5249	FY87	0	887	112	2986	0	0	0	0	0	0	0	0	3985
5249	FY88	0	816	1798	2691	1929	1706	0	1727	0	0	0	0	10667
5249	FY89	0	1168	1337	2316	956	1601	536	1799	0	0	0	0	9713
5249	FY90	0	1772	1070	2102	1606	0	0	0	0	0	0	0	6550
** BOILER LOCATION: BUILDING 5250		SERVES BUILDINGS:												FUEL TYPE: 2
5250	FY87	0	1270	738	1364	978	940	447	284	0	0	0	127	6148
5250	FY88	451	1149	995	1362	836	1255	542	419	0	0	0	0	7009
5250	FY89	0	0	0	0	0	0	0	0	0	0	0	0	0
5250	FY90	0	0	519	625	600	300	600	0	0	0	0	0	2644
** BOILER LOCATION: BUILDING 5313		SERVES BUILDINGS:												FUEL TYPE: 2
5313	FY87	0	343	175	716	891	530	274	0	0	0	0	0	2929
5313	FY88	77	465	813	1214	927	834	112	148	0	0	0	0	4590
5313	FY89	0	407	938	745	526	365	171	124	0	0	0	0	3276
5313	FY90	0	299	755	326	605	275	250	0	0	0	0	0	2510
** BOILER LOCATION: BUILDING 5316		SERVES BUILDINGS:												FUEL TYPE: 5
5316	FY87	0	0	3250	5750	4000	5500	0	0	0	0	0	0	18500
5316	FY88	0	4200	4500	0	5846	5909	0	0	0	0	0	0	20455
5316	FY89	1935	4000	3000	4500	0	5150	0	3108	0	0	0	0	21693
5316	FY90	0	0	4100	4000	0	4000	0	0	0	0	0	0	12100
** BOILER LOCATION: BUILDING 5647		SERVES BUILDINGS:												FUEL TYPE: 2
5647	FY87	0	548	1394	1786	994	256	215	135	8	0	0	0	5336
5647	FY88	610	660	450	1314	2677	1213	1282	1550	5240	0	0	0	14996
5647	FY89	723	598	1264	2339	1230	989	345	302	45	0	0	0	7835
5647	FY90	0	435	1332	770	757	581	497	0	0	0	0	0	4372
** BOILER LOCATION: BUILDING AMMO		SERVES BUILDINGS: ALL AMMO EXCEPT 2360 AREA												FUEL TYPE: 2
AMMO	FY87	291	11767	14697	24281	28202	27764	7288	856	515	452	185	127	116425
AMMO	FY88	4493	16056	17945	26163	37599	20959	5226	11054	5273	429	0	46	145243
AMMO	FY89	3180	16431	18766	22940	17271	19704	10331	9434	45	0	0	2536	120638
AMMO	FY90	2808	11428	27763	23380	14057	13332	4342	0	0	0	0	0	97110

LETTERKENNY ENERGY DATA FILE  
 FILE NAME: LTRERGY.WQ1  
 DATE: 05-Jun-91

YR	ELECT	FSD	FSR	OTHER	TOTAL
-----					
USE(MBTU)					
FY87	163,813	89,803	213,230	3,316	470,162
FY88	165,759	112,242	232,519	989	511,509
FY89	170,053	101,576	219,479	661	491,769
FY90	169,931	107,320	188,578	6,664	472,493
COST(\$)					
FY87	1,943,000	486,000	997,000	24,000	3,450,000
FY88	2,152,000	526,000	854,000	12,000	3,544,000
FY89	1,712,000	476,000	806,000	7,000	3,001,000
FY90	1,774,000	433,000	668,000	20,000	2,895,000
UNIT COST(\$/MBTU)					
FY87	11.86	5.41	4.68	7.24	7.34
FY88	12.98	4.69	3.67	12.13	6.93
FY89	10.07	4.69	3.67	10.59	6.10
FY90	10.44	4.04	3.54	3.00	6.13



## LETTERKENNY ENERGY DATA FILE

FILE NAME: LTRERGY.WQ1

DATE: 05-Jun-91

FY	MONTH	ELECT	HTG FUELS	TOTAL ENERGY	HDD	CDD	FSD	FSR	FSI/FOR	PPG	LABOR FORCE	SUPPLY MH/10	ELECT COST(\$)	HTG COST(\$)
88	Oct-87	14116	26456	40572	517	0	6390	19942	21	103			183226	106513
	Nov-87	13932	29815	43747	632	0	9337	20433	11	34	5181		180837	120036
	Dec-87	12283	51392	63675	905	0	14952	36301	11	128	5172		159433	206906
	Jan-88	12826	56585	69411	1264	0	19746	36704	16	119	5147		166481	227813
	Feb-88	13308	58472	71780	960	0	19910	38407	26	129	5019		172738	235410
	Mar-88	12314	44897	57211	715	0	16245	28593	21	38	4961		159836	180757
	Apr-88	13960	31960	45920	456	2	10241	21659	16	44	4933		181201	128672
	May-88	13393	14758	28151	153	38	4590	10122	11	35	4920		173841	59416
	Jun-88	14082	6337	20419	59	188	1205	5099	5	28	4901		182784	25513
	Jul-88	14611	4652	19263	8.5	386	1724	2886	5	37	4889		189651	18729
	Aug-88	16228	12013	28241	10	320	4928	7004	5	76	4880		210639	48365
	Sep-88	14707	8410	23117	121	30	2971	5369	5	65	4865		190897	33859
89	Oct-88	13123	22218	35341	519	2	7310	14850	16	42	4824		132149	89020
	Nov-88	13526	32948	46474	655	1	11790	21093	16	49	4874		136207	132011
	Dec-88	12915	48529	61444	1042	0	16677	31768	26	58	4919		130054	194438
	Jan-89	14127	43529	57656	983	0	13252	30108	11	158	4962		142259	174405
	Feb-89	12621	44749	57370	987	0	15361	29304	5	79	4950		127093	179293
	Mar-89	13959	51944	65903	888	0	16327	35534	11	72	4961		140567	208121
	Apr-89	13959	23618	37577	511	0	6338	17245	11	24	4963		140567	94629
	May-89	15434	18721	34155	363	18	4887	13813	5	16	4992		155420	75008
	Jun-89	14970	4728	19698	18	132	2266	2439	5	18	5034		150748	18943
	Jul-89	16690	4837	21527	14	192	1281	3533	5	18	5048		168068	19380
	Aug-89	16089	16207	32296	26	168	2534	13662	11	0	5076		162016	64936
	Sep-89	12642	9688	22330	132	60	3553	6130	5	0	5094		127305	38816
90	Oct-89	14406	16932	31338	376	16	6699	10210	11	12	5127	9970	150399	62733
	Nov-89	13846	36079	49925	704	0	13170	22878	11	20	5135	9200	144552	133674
	Dec-89	13262	66339	79601	1348	0	26125	40136	32	46	5130	8610	138455	245788
	Jan-90	13703	50795	64498	825	0	17102	33654	11	28	5100	10060	143059	188197
	Feb-90	13829	44665	58494	738	0	13485	31146	21	13	5083	9250	144375	165485
	Mar-90	12672	27977	40649	632	20	11382	16535	21	39	5071	10540	132296	103656
	Apr-90	14382	22812	37194	398	34	6099	16667	32	14	5046	9540	150148	84519
	May-90	14051	10415	24466	168	15	2936	7463	11	5	4964	11190	146692	38588
	Jun-90	13645	8478	22123	15	183	3093	5369	16	0	4927	10020	142454	31411
	Jul-90	14539	4467	19006	6	238	1043	44	3375	5	4876	8980	151787	16550
	Aug-90	15628	5745	21373	6	211	1514	1295	2935	1	4843	11910	163156	21285
	Sep-90	15966	7858	23824	102	82	4672	3181	5	0	4656	11170	166685	29114

LETTERKENNY ENERGY DATA FILE  
 FILE NAME: LTRERGY.WQ1  
 DATE: 05-Jun-91

LABOR HOURS											
FY	MONTH	BLDG 1	BLDG 12,13	BLDG14	BLDG 47N	BLDG 37	BLDG 57	BLDG 350	BLDG 351	BLDG 370	TOTAL
90	Oct-89	2357	4333	7245	2704	25450	7244	106157	6783	92995	255268
	Nov-89	1957	3706	5936	2649	25244	5866	92315	4892	81301	223866
	Dec-89	1786	4090	5570	2165	19581	5655	89961	5557	78111	212476
	Jan-90	2210	4865	6989	2399	22088	7363	105293	6178	96931	254316
	Feb-90	2105	4517	6467	2215	21191	6368	92361	5399	92052	232675
	Mar-90	2492	5502	7442	2474	24310	6642	103133	5981	107934	265910
	Apr-90	2436	4650	7051	2337	21866	6068	92862	5748	94803	237821
	May-90	2442	5018	8534	2405	20940	7177	96135	5507	88738	236896
	Jun-90	2930	4954	8767	2112	18525	6448	86059	4930	84669	219394
	Jul-90	2379	5394	8191	2043	17442	8100	80749	4624	82031	210953
	Aug-90	2729	5458	9038	2433	20359	8950	92756	4464	96851	243038
	Sep-90	2454	5684	7853	2138	18057	6994	77999	3897	86030	211106

**PRELIMINARY EVALUATION OF ECOS**

LETTERKENNY ARMY DEPOT  
PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Conveyor Warehouse NUMBER: 2

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Low Potential Savings
C. Production equipment scheduling .....	Not Applicable
D. Waste heat recovery .....	Not Applicable
E. Automated production controls .....	Not Applicable
F. Improve facility layout and space utilization .....	Low Potential Savings
G. Solar applications .....	Low Potential Savings
H. Consolidate processes and equipment requiring special environments .....	Not Applicable
I. Building ventilation and exhaust systems .....	Not Applicable
J. Production equipment maintenance .....	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Low Potential Savings
L. Steam distribution and condensate return systems .....	Low Potential Savings
M. Compressed air systems .....	Not Applicable
N. Lighting control (zones & levels) ....	Low/No Cost Project
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Low Potential Savings
Q. Loading dock seals .....	Update Previous EEAP
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Low Potential Savings
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Low Potential Savings
W. Timers to control lighting .....	Low Potential Savings
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	ECO Analysis Performed

LETTERKENNY ARMY DEPOT  
PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Conveyor Warehouse NUMBER: 4

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Low Potential Savings
C. Production equipment scheduling .....	Not Applicable
D. Waste heat recovery .....	Not Applicable
E. Automated production controls .....	Not Applicable
F. Improve facility layout and space utilization .....	Low Potential Savings
G. Solar applications .....	Low Potential Savings
H. Consolidate processes and equipment requiring special environments .....	Not Applicable
I. Building ventilation and exhaust systems .....	Not Applicable
J. Production equipment maintenance .....	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Low Potential Savings
L. Steam distribution and condensate return systems .....	Low Potential Savings
M. Compressed air systems .....	Not Applicable
N. Lighting control (zones & levels) ....	Low/No Cost Project
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Low Potential Savings
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Low Potential Savings
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Low Potential Savings
W. Timers to control lighting .....	Low Potential Savings
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	Update Previous EEAP

LETTERKENNY ARMY DEPOT  
PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Conveyor Warehouse NUMBER: 5

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Low Potential Savings
C. Production equipment scheduling .....	Not Applicable
D. Waste heat recovery .....	Not Applicable
E. Automated production controls .....	Not Applicable
F. Improve facility layout and space utilization .....	Low Potential Savings
G. Solar applications .....	Low Potential Savings
H. Consolidate processes and equipment requiring special environments .....	Not Applicable
I. Building ventilation and exhaust systems .....	Not Applicable
J. Production equipment maintenance .....	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Low Potential Savings
L. Steam distribution and condensate return systems .....	Low/No Cost Project
M. Compressed air systems .....	Not Applicable
N. Lighting control (zones & levels) ....	Oper. & Maint. Item
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Low Potential Savings
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	ECO Analysis Performed
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Low Potential Savings
W. Timers to control lighting .....	Low Potential Savings
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	Oper. & Maint. Item

**LETTERKENNY ARMY DEPOT**  
**PRELIMINARY EVALUATION OF ECO'S**

**BUILDING NAME:** Conveyor Warehouse **NUMBER:** 6

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Low Potential Savings
C. Production equipment scheduling .....	Not Applicable
D. Waste heat recovery .....	Not Applicable
E. Automated production controls .....	Not Applicable
F. Improve facility layout and space utilization .....	ECO Analysis Performed
G. Solar applications .....	Low Potential Savings
H. Consolidate processes and equipment requiring special environments .....	Not Applicable
I. Building ventilation and exhaust systems .....	Not Applicable
J. Production equipment maintenance .....	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Low Potential Savings
L. Steam distribution and condensate return systems .....	Low Potential Savings
M. Compressed air systems .....	Not Applicable
N. Lighting control (zones & levels) ....	Low/No Cost Project
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Low Potential Savings
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Low Potential Savings
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Low Potential Savings
W. Timers to control lighting .....	Low Potential Savings
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	Oper. & Maint. Item

LETTERKENNY ARMY DEPOT  
PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Conveyor Warehouse NUMBER: 7

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Low Potential Savings
C. Production equipment scheduling .....	Not Applicable
D. Waste heat recovery .....	Not Applicable
E. Automated production controls .....	Not Applicable
F. Improve facility layout and space utilization .....	Low Potential Savings
G. Solar applications .....	Low Potential Savings
H. Consolidate processes and equipment requiring special environments .....	Not Applicable
I. Building ventilation and exhaust systems .....	Not Applicable
J. Production equipment maintenance .....	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Low Potential Savings
L. Steam distribution and condensate return systems .....	Oper. & Maint. Item
M. Compressed air systems .....	Not Applicable
N. Lighting control (zones & levels) ....	Oper. & Maint. Item
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Low Potential Savings
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Not Applicable
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Low Potential Savings
W. Timers to control lighting .....	Low Potential Savings
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	Oper. & Maint. Item



**LETTERKENNY ARMY DEPOT**  
**PRELIMINARY EVALUATION OF ECO'S**

**BUILDING NAME:** Conveyor Warehouse **NUMBER:** 8

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Low Potential Savings
C. Production equipment scheduling .....	Not Applicable
D. Waste heat recovery .....	Not Applicable
E. Automated production controls .....	Not Applicable
F. Improve facility layout and space utilization .....	ECO Analysis Performed
G. Solar applications .....	Low Potential Savings
H. Consolidate processes and equipment requiring special environments .....	Not Applicable
I. Building ventilation and exhaust systems .....	Not Applicable
J. Production equipment maintenance .....	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Low Potential Savings
L. Steam distribution and condensate return systems .....	Low Potential Savings
M. Compressed air systems .....	Not Applicable
N. Lighting control (zones & levels) ....	Not Applicable
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Low Potential Savings
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Not Applicable
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Low Potential Savings
W. Timers to control lighting .....	Low Potential Savings
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	ECO Analysis Performed

LETTERKENNY ARMY DEPOT  
PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Conveyor Warehouse NUMBER: 9

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Low Potential Savings
C. Production equipment scheduling .....	Not Applicable
D. Waste heat recovery .....	Not Applicable
E. Automated production controls .....	Not Applicable
F. Improve facility layout and space utilization .....	ECO Analysis Performed
G. Solar applications .....	Low Potential Savings
H. Consolidate processes and equipment requiring special environments .....	Not Applicable
I. Building ventilation and exhaust systems .....	Not Applicable
J. Production equipment maintenance .....	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Low Potential Savings
L. Steam distribution and condensate return systems .....	Low/No Cost Project
M. Compressed air systems .....	Not Applicable
N. Lighting control (zones & levels) ....	Not Applicable
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Low Potential Savings
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Not Applicable
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Low Potential Savings
W. Timers to control lighting .....	Low Potential Savings
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	Not Applicable

**LETTERKENNY ARMY DEPOT**  
**PRELIMINARY EVALUATION OF ECO'S**

**BUILDING NAME:** Recoil Maintenance **NUMBER:** 12

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Low Potential Savings
C. Production equipment scheduling .....	Low Potential Savings
D. Waste heat recovery .....	Not Applicable
E. Automated production controls .....	Not Applicable
F. Improve facility layout and space utilization .....	Not Applicable
G. Solar applications .....	Not Applicable
H. Consolidate processes and equipment requiring special environments .....	Not Applicable
I. Building ventilation and exhaust systems .....	Not Applicable
J. Production equipment maintenance .....	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Low Potential Savings
L. Steam distribution and condensate return systems .....	Low Potential Savings
M. Compressed air systems .....	Low Potential Savings
N. Lighting control (zones & levels) ....	Low Potential Savings
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Low Potential Savings
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Low Potential Savings
S. Reflectors for fluorescent fixtures .....	Low Potential Savings
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Not Applicable
W. Timers to control lighting .....	Not Applicable
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	Low Potential Savings

LETTERKENNY ARMY DEPOT  
PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Recoil Maintenance NUMBER: 13

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Low Potential Savings
C. Production equipment scheduling .....	Low Potential Savings
D. Waste heat recovery .....	Not Applicable
E. Automated production controls .....	Not Applicable
F. Improve facility layout and space utilization .....	Not Applicable
G. Solar applications .....	Not Applicable
H. Consolidate processes and equipment requiring special environments .....	Not Applicable
I. Building ventilation and exhaust systems .....	Not Applicable
J. Production equipment maintenance .....	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Low Potential Savings
L. Steam distribution and condensate return systems .....	Low Potential Savings
M. Compressed air systems .....	Low Potential Savings
N. Lighting control (zones & levels) ....	Low Potential Savings
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Low Potential Savings
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Low Potential Savings
S. Reflectors for fluorescent fixtures .....	Low Potential Savings
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Not Applicable
W. Timers to control lighting .....	Not Applicable
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	Low Potential Savings

LETTERKENNY ARMY DEPOT  
PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Optical Systems Maintenance      NUMBER: 14

ECO Description		Project Status
A.	Production equipment changes .....	Low Potential Savings
B.	Efficient motors and variable frequency drives .....	Low Potential Savings
C.	Production equipment scheduling .....	Low Potential Savings
D.	Waste heat recovery .....	Low Potential Savings
E.	Automated production controls .....	Low Potential Savings
F.	Improve facility layout and space utilization .....	Low Potential Savings
G.	Solar applications .....	Low Potential Savings
H.	Consolidate processes and equipment requiring special environments .....	Low Potential Savings
I.	Building ventilation and exhaust systems .....	Low Potential Savings
J.	Production equipment maintenance .....	Low Potential Savings
K.	Improved methods/controls to reduce scrap, rework and "goldplating" .....	Not Applicable
L.	Steam distribution and condensate return systems .....	Low Potential Savings
M.	Compressed air systems .....	Not Applicable
N.	Lighting control (zones & levels) ....	Low Potential Savings
O.	Electrical distribution .....	Low Potential Savings
P.	Radiant heating .....	Not Applicable
Q.	Loading dock seals .....	Not Applicable
R.	Thermal energy storage .....	Low Potential Savings
S.	Reflectors for fluorescent fixtures .....	Low Potential Savings
T.	Water spray roof cooling .....	Low Potential Savings
U.	Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V.	Photocells to control lighting .....	Not Applicable
W.	Timers to control lighting .....	Not Applicable
X.	Separate switches to control lighting arrangements .....	Low Potential Savings
Y.	Other applicable ECO's .....	Low Potential Savings

# LETTERKENNY ARMY DEPOT

## PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Flamable Material Warehouse NUMBER: 19

ECO Description	Project Status
A. Production equipment changes .....	Not Applicable
B. Efficient motors and variable frequency drives .....	Low Potential Savings
C. Production equipment scheduling .....	Not Applicable
D. Waste heat recovery .....	Not Applicable
E. Automated production controls .....	Not Applicable
F. Improve facility layout and space utilization .....	Low Potential Savings
G. Solar applications .....	Low Potential Savings
H. Consolidate processes and equipment requiring special environments .....	Not Applicable
I. Building ventilation and exhaust systems .....	Low Potential Savings
J. Production equipment maintenance .....	Not Applicable
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Low Potential Savings
L. Steam distribution and condensate return systems .....	Low Potential Savings
M. Compressed air systems .....	Not Applicable
N. Lighting control (zones & levels) ....	Low/No Cost Project
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Not Applicable
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Low Potential Savings
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Low Potential Savings
W. Timers to control lighting .....	Low Potential Savings
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	Oper. & Maint. Item

**LETTERKENNY ARMY DEPOT**  
**PRELIMINARY EVALUATION OF ECO'S**

**BUILDING NAME:** Dehumidified Unheated Warehouse      **NUMBER:** 31

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Not Applicable
C. Production equipment scheduling .....	Not Applicable
D. Waste heat recovery .....	Not Applicable
E. Automated production controls .....	Not Applicable
F. Improve facility layout and space utilization .....	Not Applicable
G. Solar applications .....	Not Applicable
H. Consolidate processes and equipment requiring special environments .....	Not Applicable
I. Building ventilation and exhaust systems .....	Not Applicable
J. Production equipment maintenance .....	Not Applicable
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Not Applicable
L. Steam distribution and condensate return systems .....	Not Applicable
M. Compressed air systems .....	Not Applicable
N. Lighting control (zones & levels) ....	Low Potential Savings
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Not Applicable
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Not Applicable
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Not Applicable
W. Timers to control lighting .....	Not Applicable
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	Low Potential Savings

LETTERKENNY ARMY DEPOT  
PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Dehumidified Heated Warehouse      NUMBER: 33

ECO Description	Project Status
A. Production equipment changes .....	Not Applicable
B. Efficient motors and variable frequency drives .....	Not Applicable
C. Production equipment scheduling .....	Not Applicable
D. Waste heat recovery .....	Not Applicable
E. Automated production controls .....	Not Applicable
F. Improve facility layout and space utilization .....	Not Applicable
G. Solar applications .....	Low Potential Savings
H. Consolidate processes and equipment requiring special environments .....	Not Applicable
I. Building ventilation and exhaust systems .....	Not Applicable
J. Production equipment maintenance .....	Not Applicable
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Not Applicable
L. Steam distribution and condensate return systems .....	Low Potential Savings
M. Compressed air systems .....	Not Applicable
N. Lighting control (zones & levels) ....	Low Potential Savings
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Not Applicable
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Low Potential Savings
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Not Applicable
W. Timers to control lighting .....	Low Potential Savings
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	Low Potential Savings



**LETTERKENNY ARMY DEPOT**  
**PRELIMINARY EVALUATION OF ECO'S**

**BUILDING NAME:** Engine/Transmission Maintenance      **NUMBER:** 37

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Low Potential Savings
C. Production equipment scheduling .....	Not Applicable
D. Waste heat recovery .....	ECO Analysis Performed
E. Automated production controls .....	ECO Analysis Performed
F. Improve facility layout and space utilization .....	Low Potential Savings
G. Solar applications .....	Low Potential Savings
H. Consolidate processes and equipment requiring special environments .....	Low Potential Savings
I. Building ventilation and exhaust systems .....	ECO Analysis Performed
J. Production equipment maintenance .....	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Not Applicable
L. Steam distribution and condensate return systems .....	Not Applicable
M. Compressed air systems .....	Low Potential Savings
N. Lighting control (zones & levels) ....	Low Potential Savings
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Not Applicable
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Not Applicable
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Not Applicable
V. Photocells to control lighting .....	Not Applicable
W. Timers to control lighting .....	Not Applicable
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	Low Potential Savings

LETTERKENNY ARMY DEPOT  
PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Dehumidified Heated Warehouse      NUMBER: 43

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Low Potential Savings
C. Production equipment scheduling .....	Low Potential Savings
D. Waste heat recovery .....	Low Potential Savings
E. Automated production controls .....	Low Potential Savings
F. Improve facility layout and space utilization .....	Low Potential Savings
G. Solar applications .....	Low Potential Savings
H. Consolidate processes and equipment requiring special environments .....	Low Potential Savings
I. Building ventilation and exhaust systems .....	Low Potential Savings
J. Production equipment maintenance .....	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Not Applicable
L. Steam distribution and condensate return systems .....	Low Potential Savings
M. Compressed air systems .....	Not Applicable
N. Lighting control (zones & levels) ....	Low Potential Savings
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Not Applicable
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Low Potential Savings
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Not Applicable
W. Timers to control lighting .....	Low Potential Savings
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	Low Potential Savings

# LETTERKENNY ARMY DEPOT

## PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Chemical Equipment Maintenance NUMBER: 57-NC

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Low Potential Savings
C. Production equipment scheduling .....	Low Potential Savings
D. Waste heat recovery .....	Low Potential Savings
E. Automated production controls .....	Low Potential Savings
F. Improve facility layout and space utilization .....	Low Potential Savings
G. Solar applications .....	Low Potential Savings
H. Consolidate processes and equipment requiring special environments .....	Not Applicable
I. Building ventilation and exhaust systems .....	Low Potential Savings
J. Production equipment maintenance .....	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Not Applicable
L. Steam distribution and condensate return systems .....	Not Applicable
M. Compressed air systems .....	Low/No Cost Project
N. Lighting control (zones & levels) ....	Low Potential Savings
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Not Applicable
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Low Potential Savings
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Not Applicable
W. Timers to control lighting .....	Not Applicable
X. Separate switches to control lighting arrangements .....	Not Applicable
Y. Other applicable ECO's .....	Low Potential Savings

LETTERKENNY ARMY DEPOT  
PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Battery Charging Shop NUMBER: 57-NW

ECO Description		Project Status
A.	Production equipment changes .....	Low Potential Savings
B.	Efficient motors and variable frequency drives .....	Low Potential Savings
C.	Production equipment scheduling .....	Low Potential Savings
D.	Waste heat recovery .....	Low Potential Savings
E.	Automated production controls .....	Low Potential Savings
F.	Improve facility layout and space utilization .....	Low Potential Savings
G.	Solar applications .....	Not Applicable
H.	Consolidate processes and equipment requiring special environments .....	Not Applicable
I.	Building ventilation and exhaust systems .....	Not Applicable
J.	Production equipment maintenance .....	Not Applicable
K.	Improved methods/controls to reduce scrap, rework and "goldplating" .....	Not Applicable
L.	Steam distribution and condensate return systems .....	Not Applicable
M.	Compressed air systems .....	Not Applicable
N.	Lighting control (zones & levels) ....	Low Potential Savings
O.	Electrical distribution .....	Low Potential Savings
P.	Radiant heating .....	Low Potential Savings
Q.	Loading dock seals .....	Not Applicable
R.	Thermal energy storage .....	Not Applicable
S.	Reflectors for fluorescent fixtures .....	Low Potential Savings
T.	Water spray roof cooling .....	Not Applicable
U.	Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V.	Photocells to control lighting .....	Not Applicable
W.	Timers to control lighting .....	Not Applicable
X.	Separate switches to control lighting arrangements .....	Low Potential Savings
Y.	Other applicable ECO's .....	Low Potential Savings

# LETTERKENNY ARMY DEPOT

## PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Depot Vehicle Maintenance

NUMBER: 57-S

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Low Potential Savings
C. Production equipment scheduling .....	Low Potential Savings
D. Waste heat recovery .....	Low Potential Savings
E. Automated production controls .....	Low Potential Savings
F. Improve facility layout and space utilization .....	Low Potential Savings
G. Solar applications .....	Not Applicable
H. Consolidate processes and equipment requiring special environments .....	Low Potential Savings
I. Building ventilation and exhaust systems .....	Low Potential Savings
J. Production equipment maintenance .....	Not Applicable
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Not Applicable
L. Steam distribution and condensate return systems .....	Not Applicable
M. Compressed air systems .....	Low Potential Savings
N. Lighting control (zones & levels) ....	Low Potential Savings
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Low Potential Savings
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Low Potential Savings
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Not Applicable
W. Timers to control lighting .....	Not Applicable
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	Low Potential Savings

# LETTERKENNY ARMY DEPOT

## PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: New Vehicle Care

NUMBER: 320

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Oper. & Maint. Item
C. Production equipment scheduling .....	Low Potential Savings
D. Waste heat recovery .....	Low Potential Savings
E. Automated production controls .....	Low Potential Savings
F. Improve facility layout and space utilization .....	Low Potential Savings
G. Solar applications .....	Low Potential Savings
H. Consolidate processes and equipment requiring special environments .....	Not Applicable
I. Building ventilation and exhaust systems .....	ECO Analysis Performed
J. Production equipment maintenance .....	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Low Potential Savings
L. Steam distribution and condensate return systems .....	Update Previous EEAP
M. Compressed air systems .....	Low/No Cost Project
N. Lighting control (zones & levels) ....	Low/No Cost Project
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Low Potential Savings
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Low Potential Savings
T. Water spray roof cooling .....	Low Potential Savings
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Low Potential Savings
W. Timers to control lighting .....	Low Potential Savings
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	ECO Analysis Performed

LETTERKENNY ARMY DEPOT  
PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Vehicle Maintenance NUMBER: 350

ECO Description	Project Status
A. Production equipment changes .....	ECO Analysis Performed
B. Efficient motors and variable frequency drives .....	Oper. & Maint. Item
C. Production equipment scheduling .....	Low Potential Savings
D. Waste heat recovery .....	Update Previous EEAP
E. Automated production controls .....	Low Potential Savings
F. Improve facility layout and space utilization .....	Low Potential Savings
G. Solar applications .....	Low Potential Savings
H. Consolidate processes and equipment requiring special environments .....	Not Applicable
I. Building ventilation and exhaust systems .....	ECO Analysis Performed
J. Production equipment maintenance .....	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Low Potential Savings
L. Steam distribution and condensate return systems .....	Low Potential Savings
M. Compressed air systems .....	ECO Analysis Performed
N. Lighting control (zones & levels) ....	Low Potential Savings
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Low Potential Savings
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Low Potential Savings
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Low Potential Savings
W. Timers to control lighting .....	Low Potential Savings
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	Update Previous EEAP

# LETTERKENNY ARMY DEPOT

## PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Indust./Ground Water Treatment NUMBER: 360

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Not Applicable
C. Production equipment scheduling .....	Not Applicable
D. Waste heat recovery .....	Not Applicable
E. Automated production controls .....	Not Applicable
F. Improve facility layout and space utilization .....	Not Applicable
G. Solar applications .....	Not Applicable
H. Consolidate processes and equipment requiring special environments .....	Not Applicable
I. Building ventilation and exhaust systems .....	Not Applicable
J. Production equipment maintenance .....	Not Applicable
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Not Applicable
L. Steam distribution and condensate return systems .....	Not Applicable
M. Compressed air systems .....	Not Applicable
N. Lighting control (zones & levels) ....	Low Potential Savings
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Low Potential Savings
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Not Applicable
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Not Applicable
W. Timers to control lighting .....	Low Potential Savings
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	Low Potential Savings



# LETTERKENNY ARMY DEPOT

## PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Electronic Systems Maint.

NUMBER: 370

ECO Description	Project Status
A. Production equipment changes .....	ECO Analysis Performed
B. Efficient motors and variable frequency drives .....	Oper. & Maint. Item
C. Production equipment scheduling .....	Low Potential Savings
D. Waste heat recovery .....	Low Potential Savings
E. Automated production controls .....	Low Potential Savings
F. Improve facility layout and space utilization .....	Low Potential Savings
G. Solar applications .....	Low Potential Savings
H. Consolidate processes and equipment requiring special environments .....	Low Potential Savings
I. Building ventilation and exhaust systems .....	Low Potential Savings
J. Production equipment maintenance .....	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Low Potential Savings
L. Steam distribution and condensate return systems .....	Low Potential Savings
M. Compressed air systems .....	Low/No Cost Project
N. Lighting control (zones & levels) ....	Low/No Cost Project
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Low Potential Savings
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Low Potential Savings
S. Reflectors for fluorescent fixtures .....	ECO Analysis Performed
T. Water spray roof cooling .....	Low Potential Savings
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Low Potential Savings
W. Timers to control lighting .....	Low Potential Savings
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	ECO Analysis Performed

LETTERKENNY ARMY DEPOT  
PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Production Equipment Maint.      NUMBER: 422

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Not Applicable
C. Production equipment scheduling .....	Low Potential Savings
D. Waste heat recovery .....	Not Applicable
E. Automated production controls .....	Not Applicable
F. Improve facility layout and space utilization .....	Low Potential Savings
G. Solar applications .....	Low Potential Savings
H. Consolidate processes and equipment requiring special environments .....	Low Potential Savings
I. Building ventilation and exhaust systems .....	Low Potential Savings
J. Production equipment maintenance .....	Not Applicable
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Not Applicable
L. Steam distribution and condensate return systems .....	Low/No Cost Project
M. Compressed air systems .....	Not Applicable
N. Lighting control (zones & levels) ....	Low Potential Savings
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Not Applicable
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Low Potential Savings
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Not Applicable
W. Timers to control lighting .....	Not Applicable
X. Separate switches to control lighting arrangements .....	Not Applicable
Y. Other applicable ECO's .....	Low Potential Savings

LETTERKENNY ARMY DEPOT  
PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Upholstery, Wood & Optics Maint      NUMBER: 424

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Low Potential Savings
C. Production equipment scheduling .....	Not Applicable
D. Waste heat recovery .....	Low Potential Savings
E. Automated production controls .....	Not Applicable
F. Improve facility layout and space utilization .....	Low Potential Savings
G. Solar applications .....	Low Potential Savings
H. Consolidate processes and equipment requiring special environments .....	Not Applicable
I. Building ventilation and exhaust systems .....	Low Potential Savings
J. Production equipment maintenance .....	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Not Applicable
L. Steam distribution and condensate return systems .....	Low/No Cost Project
M. Compressed air systems .....	Not Applicable
N. Lighting control (zones & levels) ....	Low/No Cost Project
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Not Applicable
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Low Potential Savings
T. Water spray roof cooling .....	Low Potential Savings
U. Occupancy sensors to control lighting or HVAC systems .....	Low/No Cost Project
V. Photocells to control lighting .....	Not Applicable
W. Timers to control lighting .....	Not Applicable
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	Low Potential Savings

# LETTERKENNY ARMY DEPOT

## PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Water Treatment Plant

NUMBER: 554

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Low Potential Savings
C. Production equipment scheduling .....	Not Applicable
D. Waste heat recovery .....	Not Applicable
E. Automated production controls .....	Low Potential Savings
F. Improve facility layout and space utilization .....	Not Applicable
G. Solar applications .....	Not Applicable
H. Consolidate processes and equipment requiring special environments .....	Not Applicable
I. Building ventilation and exhaust systems .....	Not Applicable
J. Production equipment maintenance .....	Not Applicable
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Not Applicable
L. Steam distribution and condensate return systems .....	Low Potential Savings
M. Compressed air systems .....	Not Applicable
N. Lighting control (zones & levels) ....	Low Potential Savings
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Low Potential Savings
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Low Potential Savings
T. Water spray roof cooling .....	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Not Applicable
W. Timers to control lighting .....	Low Potential Savings
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	Low Potential Savings

LETTERKENNY ARMY DEPOT  
PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Sewage Treatment Plant NUMBER: 2326

ECO Description	Project Status
A. Production equipment changes .....	Low Potential Savings
B. Efficient motors and variable frequency drives .....	Low Potential Savings
C. Production equipment scheduling .....	Low Potential Savings
D. Waste heat recovery .....	Not Applicable
E. Automated production controls .....	Low Potential Savings
F. Improve facility layout and space utilization .....	Not Applicable
G. Solar applications .....	Not Applicable
H. Consolidate processes and equipment requiring special environments .....	Low Potential Savings
I. Building ventilation and exhaust systems .....	Not Applicable
J. Production equipment maintenance .....	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating" .....	Not Applicable
L. Steam distribution and condensate return systems .....	Not Applicable
M. Compressed air systems .....	Not Applicable
N. Lighting control (zones & levels) ....	Low Potential Savings
O. Electrical distribution .....	Low Potential Savings
P. Radiant heating .....	Low Potential Savings
Q. Loading dock seals .....	Not Applicable
R. Thermal energy storage .....	Not Applicable
S. Reflectors for fluorescent fixtures .....	Low Potential Savings
T. Water spray roof cooling .....	Low Potential Savings
U. Occupancy sensors to control lighting or HVAC systems .....	Low Potential Savings
V. Photocells to control lighting .....	Not Applicable
W. Timers to control lighting .....	Low Potential Savings
X. Separate switches to control lighting arrangements .....	Low Potential Savings
Y. Other applicable ECO's .....	Low Potential Savings

ECO CALCULATIONS AND COST ESTIMATES

**SECTION IV**  
**ECO CALCULATIONS AND COST ESTIMATES**

<b>ECO #</b>	<b>Description</b>	<b>Page</b>
1	Compressed air valve replacement in Building 350	1-1
2	"Steam" cleaning heat method modification	2-1
3	Dip tank covers	3-1
4	Heat recovery from paint booth exhaust air	4-1
5	EMCS in Building 370	5-1
6	Heat recovery from condensate in Building 349	6-1
7	No. 6 fuel oil recirculation control in Building 349	7-1
8	Reflectors for fluorescent fixtures in Building 370	8-1
9	Paint booth fan controls	9-1
10	Paint booth air flow control	10-1
11	Blast booth fan cut off	11-1
12	Boiler conversion to #5 fuel oil	12-1
13	Energy efficient fluorescent lamps in Building 370	13-1
14	Energy efficient frequency converters in Building 370	14-1
15	Modular offices in Buildings 6-South, 8 & 9	15-1
16	Boiler conversion to natural gas	16-1
D-UP	Heat recovery from paint booths and engine test cells	D-UP-1
E-UP	Vapor barrier for dehumidified warehouses	E-UP-1
G-UP	Dip tank exhaust heat recovery in Building 350-North	G-UP-1
H-UP	Baghouse insulation and exhaust air return	H-UP-1
I-UP	Large paint booth exhaust heat recovery in Building 350	I-UP-1
J-UP	Medium paint booth exhaust heat recovery in Building 350	J-UP-1
N-UP	Window and wall insulation in 400-series buildings	N-UP-1
R-UP	High pressure sodium lighting in warehouses	R-UP-1
G-E-UP	Paint booth exhaust heat recovery in Building 1	G-E-UP-1
G-F-UP	Paint booth exhaust heat recovery in Building 14	G-F-UP-1
G-G-UP	Paint booth exhaust heat recovery in Building 37	G-G-UP-1
G-I-UP	Dip tank exhaust heat recovery in Building 350-South	G-I-UP-1



SUBJECT LETTERKENNY A.D.  
ECO #1  
DESIGNER G. FALLON  
CHECKER P. Hutchins

AEP NO 290-0379-001  
SHEET 1 OF 1  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

## ECO #1 Compressed Air Valve Replacement in Bldg 350

EACH COLUMN CONTAINS AT LEAST ONE COMPRESSED AIR ROOT VALVE. DRAWINGS SHOW 4 ROWS OF 57 COLUMNS EACH, TOTAL 228 COLUMNS  $\Rightarrow$  228 AIR STATIONS. 40 COL'S HAD LEAKS.

### COLUMNS SURVEYED

B19 THRU B57 AND C11 THRU C57  $\Rightarrow$  84 COL'S

### PERCENT W/LEAKS

$$\frac{40}{84} \times 100 = 47.62\%$$

### ESTIMATED COL'S W/LEAKS

$$228 \text{ COL'S} \times .4762 = 109 \text{ COL'S.}$$

### TOTAL ESTIMATED LEAKAGE

$$\text{LEAKS} = 31 \text{ CFM}$$

$$\frac{31 \text{ CFM}}{40 \text{ COL'S}} \times 109 \text{ COL'S} = 84.5 \text{ CFM.}$$

### TOTAL VALUE OF LEAKS

$$\frac{84.5 \text{ CFM}}{1000 \text{ cf}} \times \frac{60 \text{ min}}{\text{H}} \times \frac{3760 \text{ H}}{\text{Yr.}} \times \frac{0.009 \text{ MBTU}}{1000 \text{ cf}} \times \frac{\$10.94}{\text{MBTU}} \approx \$4000/\text{YR}$$

### TOTAL ENERGY SAVED

$$\frac{\$4000}{\text{YR}} \times \frac{\text{MBTU}}{\$10.94} = \underline{\underline{366 \text{ MBTU/YR.}}}$$



Project No. 290-0379-001

Local \_\_\_\_\_ L.D. ☒ Placed ☒ Rec'd. \_\_\_\_\_ Date \_\_\_\_\_

Gr. Fallon \_\_\_\_\_ Conversed With Tom Knowland \_\_\_\_\_

Of Ingersoll-Rand \_\_\_\_\_ Regarding Compressor Energy Use \_\_\_\_\_

TK gave the following energy use values:

				kwh/kcf	MBtu/kcf
CFM	Bhp	PSIG	Btu/CFM	<del>total</del>	<del>net</del>
1595	319	110	509	<del>2.70</del>	0.0092
1560	330	125	538	2.86	0.0098
1603	306	100	485	2.57	0.0088

CALC ENERGY USE PER ~~MB~~ CFM OF AIR

MOTOR EFF = 0.92

Distribution:



SUBJECT LEAD ECO #1  
DESIGNER G. Fellen  
CHECKER P. Hutchins

AEP NO \_\_\_\_\_  
SHEET 2 OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

### COST OF BALL VALVE

FROM MEANS, ITEM 151-955-1470

AND FROM CONSTRUCTION COST CALCULATION (ATTACHED)

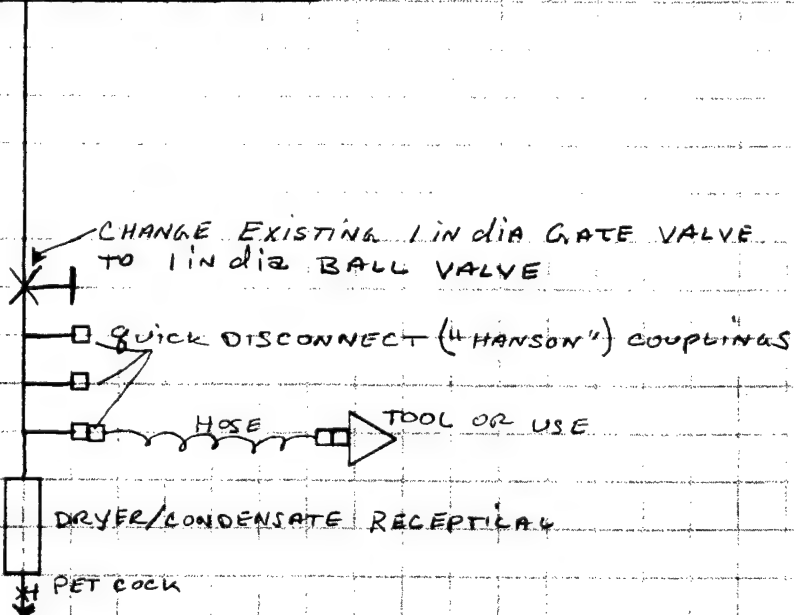
228 VALVES = \$8131

### PAYBACK

$$\frac{\$8131}{\$4000/\text{yr}} = 2.0 \text{ years}$$

### SKETCH

SUPPLY AIR HEADER



NOTE: EXISTING GATE VALVE OFTEN HAS LEAKY VALVE STEM AND ARE RARELY CLOSED. THIS ALLOWS DOWNSTREAM LEAKS TO CONTINUE. VALVE IS "DIFFICULT" TO SHUT OFF. BALL VALVE IS QUICK SHUT OFF TYPE. THEREFORE MORE LIKELY TO BE SHUT OFF BY WORKERS WHEN ASKED TO DO SO.

05/09/91

# ECO Construction Cost Estimate Calculations

ECO Name: Air Valves Replacement in Building 350

ECO #: 1

1991 ECO "bare" costs (from cost estimate sheet)		
Material		\$2,109
Labor		\$2,440
	Subtotal bare costs	\$4,549
FICA Insurance (20% of Labor)		\$488
Sales Tax (6.5% of Material)		\$137
	Subtotal	\$5,174
Overhead (15%)		\$776
	Subtotal	\$5,950
Profit (10%)		\$595
	Subtotal	\$6,545
Bond (1%)		\$65
	Subtotal	\$6,610
Contingency (10%)		\$661
Subtotal (Construction Cost Input For LCCID *)		\$7,271
SIOH (5.5% of Construction Cost)		\$400
	Subtotal	\$7,671
Design (6% of Construction Cost)		\$436
Total Project Cost		\$8,107

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

# CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET OF

PROJECT

ENERGY ENGINEERING ANALYSIS

LOCATION

Letterkenny Army Depot

ARCHITECT ENGINEER

REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE

- ☐ CODE A (No design completed)  
☐ CODE B (Preliminary design)  
☐ CODE C (Final design)  
☐ OTHER (Specify)

DRAWING NO.

ESTIMATOR

G. Fallon

CHECKED BY

ECD #1

SUMMARY

QUANTITY

LABOR

MATERIAL

TOTAL COST

NO. UNITS

UNIT MEAS.

PER UNIT

TOTAL

PER UNIT

TOTAL

1 in Ø BALL VALVE

228

EA

10.70

2440

9.25

2109

4549

ECO#1

LETTERKENNY ARMY DEPOT  
COMPRESSED AIR SURVEY  
BUILDING 350

COLUMN/ LOCATION	LEAK* DETECTION	FLOW** (CFM)	COMMENT
ID	TECHNIQUE		
B26	A	0.659	VALVE PACKING (MEASURED)
B54	A	1	VALVE PACKING
C24	A	1.5	1 HOSE COUPLING
C28	A	1.5	DRYER DRAIN
C32	A	1.5	VALVE PACKING
C47	A	1	VALVE PACKING
PB60	A	4.1	DRYER DRAIN PAINT BOOTH 60 (MEASURED)
B19	D	<0.5	VALVE PACKING (MEASURED)
B23	D	<0.5	VALVE PACKING
B27	D	<0.5	HOSE COUPLING
B30	D	<0.5	HOSE COUPLING
B31	D	<0.5	HOSE COUPLING
B35	D	<1.5	3 HOSE COUPLING
B36	D	<0.5	1 HOSE COUPLING
B37	D	<0.5	1 HOSE COUPLING (BREATHABLE AIR)
B38	D	>0.5	1 HOSE COUPLING
B50	D	<0.5	VALVE PACKING
C21	D	<0.5	1 HOSE COUPLING
C36	D	<0.5	1 HOSE COUPLING
C38	D	<0.5	VALVE PACKING (BREATHABLE AIR)
C39	D	<0.5	VALVE PACKING (BREATHABLE AIR)
C42	D	<0.5	VALVE PACKING
C46	D	<0.5	1 HOSE COUPLING
C51	D	<0.5	1 HOSE COUPLING
C52	D	<0.5	1 HOSE COUPLING
C54	D	<0.5	1 HOSE COUPLING
C55	D	<0.5	DRAIN COCK
B39	F	1	1 HOSE COUPLING
B46	F	1	VALVE PACKING (MEASURED)
B48	F	1	VALVE PACKING
B51	F	1	VALVE PACKING
B55	F	1	DRAIN COCK
C11	F	<1	1 HOSE COUPLING
C13	F	<1	1 HOSE COUPLING
C14	F	1	DRYER DRAIN
C17	F	<1	1 HOSE COUPLING
C18	F	<1	1 HOSE COUPLING
C23	F	1	1 HOSE COUPLING
C25	F	1	1 HOSE COUPLING
C31	F	1	1 HOSE COUPLING
C45	F	1	VALVE PACKING

31

- \* A = AUDIBLE TO HUMAN EAR WITH "AT WORK" BACKGROUND NOISE  
D = DETECTOR ONLY. LEAK COULD NOT BE HEARD OR FELT  
F = CAN BE FELT WITH HAND

- \*\* FLOW WAS MEASURED IN EACH OF THE MAJOR CATAGORIES (A,D,F).  
FLOW WAS ESTIMATED BASED ON CATAGORY OF DETECTION SENSITIVITY

SUBJECT LEAD ECO #2AEP NO 290.0379-001DESIGNER G. Fallon

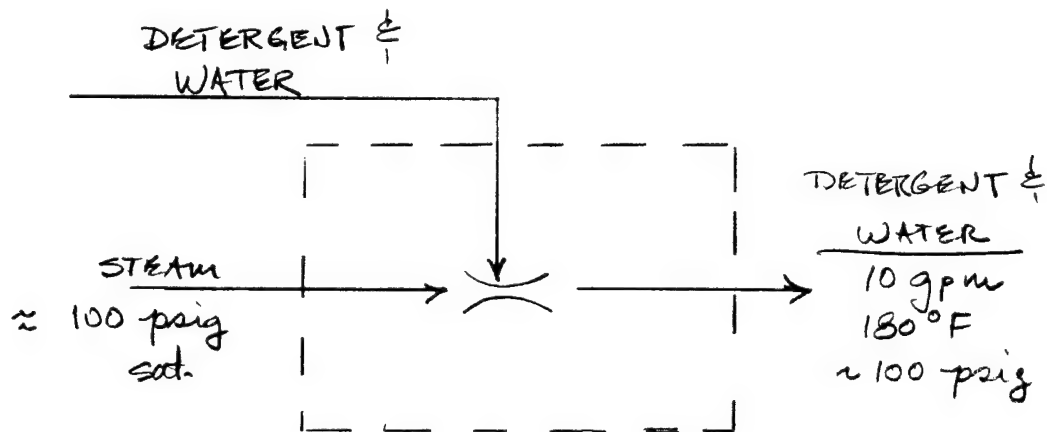
SHEET \_\_\_\_\_ OF \_\_\_\_\_

CHECKER P. Hutchins

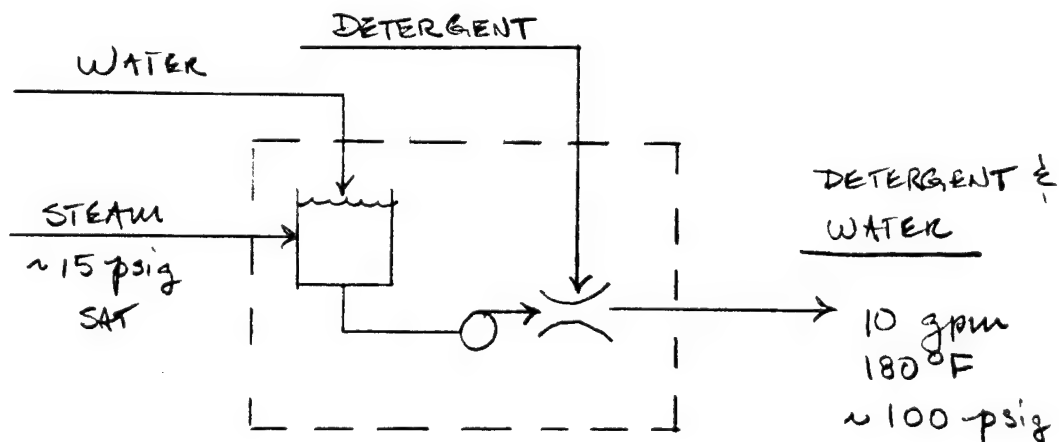
DATE \_\_\_\_\_

DATE 9/25/91

## ECO #2 - Modify "Steam" Cleaning Method



EXISTING METHOD



PROPOSED METHOD

There is no change in energy consumption between the two methods. However energy and manpower savings can result in the boiler plant, Bldg. 349.



SUBJECT ECO #2  
DESIGNER G. Follen  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET \_\_\_\_\_ OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

Manpower savings result from reduced safety requirements and thermal stresses for a low pressure boiler. This would allow a reduction in manpower for operation and allow shut down on weekends.

However, Keeler representatives would not recommend lower the boiler pressure below 50 psig. Also LEAD personnel have begun shutting the boiler plant down on weekends (summer, 1991).

Energy savings could be realized by installing a pressure reducing valve at the boiler house. Savings would be due to reduced steam flow through existing steam leaks and reduced conduction losses through steam lines.

In this case losses through underground, insulated steam lines is small. Steam leaks should be fixed regardless of the pressure.



SUBJECT ECO #2  
\_\_\_\_\_  
DESIGNER G. Fallon  
\_\_\_\_\_  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET \_\_\_\_\_ OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

The result is there are no manpower  
to be realized. Energy savings are minimal  
and difficult to quantify.



05/09/91

ECO Construction Cost Estimate  
Calculations

ECO Name: Steam clean modification

ECO #: 2

1991 ECO "bare" costs (from cost estimate sheet)

Material	\$5,476
Labor	\$4,124

Subtotal bare costs	\$9,600
---------------------	---------

FICA Insurance (20% of Labor)	\$825
-------------------------------	-------

Sales Tax (6.5% of Material)	\$356
------------------------------	-------

Subtotal	\$10,781
----------	----------

Overhead (15%)	\$1,617
----------------	---------

Subtotal	\$12,398
----------	----------

Profit (10%)	\$1,240
--------------	---------

Subtotal	\$13,638
----------	----------

Bond (1%)	\$136
-----------	-------

Subtotal	\$13,774
----------	----------

Contingency (10%)	\$1,377
-------------------	---------

Subtotal (Construction Cost Input For LCCID *)	\$15,151
--	----------

SIOH (5.5% of Construction Cost)	\$833
----------------------------------	-------

Subtotal	\$15,984
----------	----------

Design (6% of Construction Cost)	\$909
----------------------------------	-------

Total Project Cost	\$16,893
--------------------	----------

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

<div style="text-align: center;"> <b>REYNOLDS, SMITH &amp; HILLS</b>          ARCHITECTS      ENGINEERS      PLANNERS       </div>			
PROJECT <i>ECO #2 "Steam" Clean Modification</i>			SHEET _____ OF _____
LOCATION <i>LETTERKENNY ARMY DEPOT</i>			A E FILE NO. _____
CONSTRUCTION COST ESTIMATE			DATE _____
BASIS FOR ESTIMATE <input type="checkbox"/> PRE-DESIGN STUDY <input checked="" type="checkbox"/> SCHEMATIC DESIGN <input type="checkbox"/> DESIGN DEVELOPMENT <input type="checkbox"/> FINAL DESIGN			ESTIMATOR <i>G. Fallon</i> CHECKER <i>P. Hudek</i>

RSH 52D (Sept 1979)

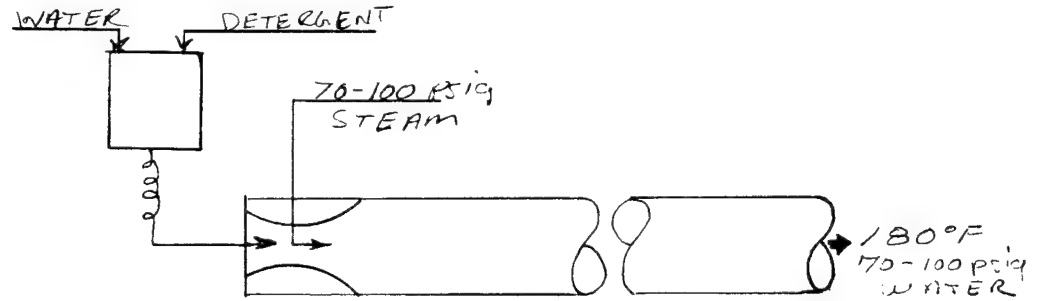


SUBJECT LEAD ECO #2  
DESIGNER G. Fallon  
CHECKER \_\_\_\_\_

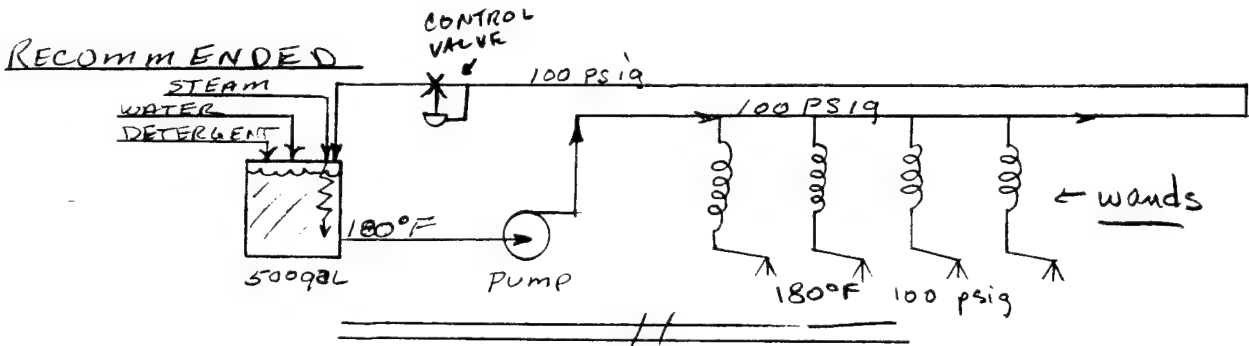
AEP NO \_\_\_\_\_  
SHEET \_\_\_\_\_ OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

## SCHEMATIC FLOW DIAGRAM

### CURRENT

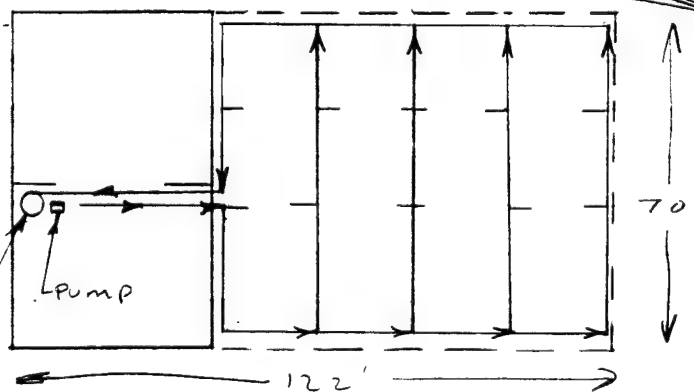


### CLEANING WAND



### PHYSICAL LOCATION

BLDG 351



$$\text{PIPE } (70 \times 5) + (40 \times 2) + (0 \times 2) \\ = 450' \approx 500'$$

500 gal tank.

SUBJECT LETTERKENNY EZAPAEP NO 290-0379-001ECO #3SHEET 1 OF 4DESIGNER G.F.DATE 3-21-91CHECKER JTH

DATE \_\_\_\_\_

ECO # 3 Dip TANK COVERS with Exhaust Fan Controls

## ASSUMPTIONS:

1. ROOM TEMPERATURE = 68°F

2. HEAT LOAD FACTOR (HLF)

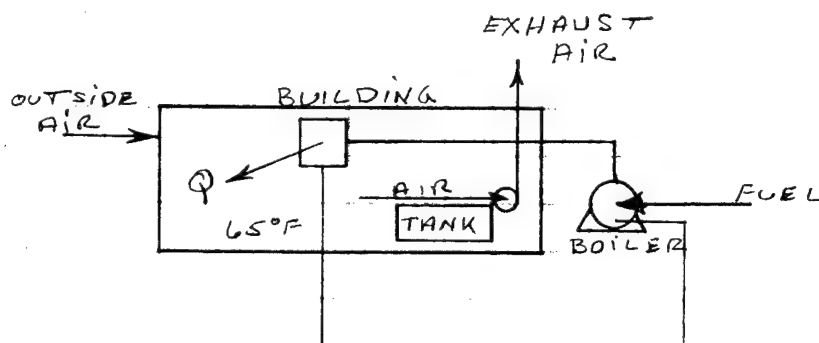
HLF<sub>1</sub> = 0.166 MBTU/yr.cfm (24h/d, 7d/w)HLF<sub>2</sub> = 0.0742 MBTU/yr.cfm (16h/d, 5d/w)

3. FAN EFFICIENCY = 0.5

4. STEAM GENERATION EFFICIENCY = 0.8

5. FAN ΔP = 3 IN. W.C.

6. LEAKAGE FLOW WITH COVER IN PLACE = 1% DESIGN FLS

CURRENT ENERGY USE (TANK 431B, BLDG 37)

$$Q = \frac{\text{CFM} \times \text{HEAT LOSS FACTOR (MBTU/CFM \cdot R)}}{\text{STEAM GEN. EFF}}$$

$$= \frac{5200 \times 0.166}{0.8} = 1079 \text{ MBTU/yr} \quad \# 2 \text{ F.O.}$$

CURRENT FAN ENERGY USE

$$\text{FAN HP} \times \text{BTU/HPHR} \times 8760 \text{ HRR/yr} \times \frac{\text{MBTU}}{10^6 \text{ BTU}} =$$

$$\frac{5200 \times 3}{6356 \times 0.5} \text{ HP} \times 2545 \text{ BTU/HPHR} \times 8760 \text{ HRR/yr} \times \frac{1}{10^6} = 109 \text{ MBTU/yr}$$

ELECTRIC

SUBJECT LETTERKENNY EEAP

AEP NO \_\_\_\_\_

DESIGNER G. F.SHEET 2 OF 4

CHECKER \_\_\_\_\_

DATE 3-21-91

DATE \_\_\_\_\_

ENERGY CONSUMPTION (1) COVER

$$\begin{aligned} & (16 \text{ w/d, sd/w}) \quad (8 \text{ w/d sd/w + two weekends}) \\ Q &= \text{HEAT LOSS IN OPERATION} + \text{HEAT LOSS COVERED} \\ &= \frac{\text{CFM} \times \text{HLF}}{\eta} + \frac{(\text{LEAKAGE CFM} \times (\text{HLF}_1 - \text{HLF}_2))}{\eta} \\ &= \frac{5200 \times 0.0742}{0.8} + \frac{52 \times (0.166 - 0.0742)}{0.8} = 488 \text{ MBTU/yr} \end{aligned}$$

FAN ENERGY CONSUMPTION (1) COVER

NOTE: FAN ΔP CONTROLS WILL REDUCE FAN SPEED VIA A VARIABLE FREQUENCY DRIVE TO MAINTAIN SET ΔP WHEN COVER IS IN PLACE.

Consumption = ENERGY USE WHILE COVERED & UNCOVERED.

UNCOVERED CONSUMPTION

$$\begin{aligned} &= \text{CURRENT FAN USE} \times \frac{\text{UNCOVERED TIME}}{\text{TOTAL TIME}} \\ &= 109 \times \frac{4160}{8760} = 51.76 \text{ MBTU ELEC/yr} \end{aligned}$$

COVERED CONSUMPTION

$$\frac{52 \times 3}{6356 \times .5} \text{ (HP)} \times \frac{2545 \text{ BTU}}{\text{HP HR}} \times (8760 - 3035) \text{ HRS/yr} \times \frac{\text{MBTU}}{10^6 \text{ BTU}} = 0.715 \text{ MBTU EL/yr}$$

TOTAL CONSUMPTION

$$\begin{aligned} \text{TOTAL} &= \text{COVERED} + \text{UNCOVERED} \\ &= 0.715 + 51.76 = 52.47 \text{ MBTU elec/yr} \end{aligned}$$

SUBJECT LETTERKENNY EEAP

AEP NO \_\_\_\_\_

DESIGNER S.F.SHEET 3 OF 4

CHECKER \_\_\_\_\_

DATE 3/21/91

DATE \_\_\_\_\_

SAVINGSFUEL OIL

$$\begin{aligned}\text{SAVINGS} &= (\text{CURRENT}) - (\text{COVER}) \\ &= 1079 \frac{\text{MBTU}}{\text{YR}} - 488 \frac{\text{MBTU}}{\text{YR}} \\ &= \underline{591} \text{ MBTU/YR} \quad \#2 \text{ FUEL OIL}\end{aligned}$$

ELECTRICITY

$$\begin{aligned}\text{SAVINGS} &= (\text{CURRENT}) - (\text{COVER}) \\ &= 109 - 52.47 \\ &= \underline{56.53} \text{ MBTU ELEC/YR}\end{aligned}$$

TOTAL PEROS

## ASSUMPTIONS:

- 1) ALL TANK FANS OPERATE CONTINUOUSLY AT DESIGN FLOW (PER OSHA REQUIREMENTS)
- 2) TANKS ARE "USED" 2 SHIFTS / DAY, 5 d/w, 32w/yr

APPROACH: 1) CALCULATE UNIT HEAT SAVING FACTOR FROM SINGLE TANK PROCEDURE ABOVE  
2) APPLY FACTORS TO ALL OTHER TANKS  
3) SUM RESULTS FOR TOTAL FACILITY.

$$\begin{aligned}\text{UNIT HEAT SAVING FACTOR} &= \frac{\text{HEAT SAVED}}{\text{CFM}} \\ \text{UHSF} &= \frac{591 \text{ MBTU/yr}}{5200 \text{ CFM}} = 0.1137 \frac{\text{MBTU}}{\text{CFM YR}}\end{aligned}$$

SUBJECT LETTERKENNY E&AP

AEP NO \_\_\_\_\_

SHEET 4 OF 4DESIGNER G. F.DATE 3-21-91

CHECKER \_\_\_\_\_

DATE \_\_\_\_\_

$$\text{UNIT ELECTRICITY SAVING FACTOR} = \frac{\text{ELECTRIC ENERGY SAVED}}{\text{CFM}}$$

$$\text{UESF} = \frac{56.53 \text{ MBTU ELEC}}{5200 \text{ CFM}} \div \frac{4 \text{ R}}{\text{YR}} = 0.0109 \frac{\text{MBTU ELEC}}{\text{CFM YR.}}$$

APPLYING THESE FACTORS TO EACH VENTED TANK  
(SEE ENCLOSED SPREADSHEET CALCULATION) YIELDS:

TOTAL FACILITY HEAT SAVED =  $\Sigma$  INDIVIDUAL TANKS.

$$= \underline{\underline{26,034}} \text{ MBTU FUEL/YR}$$

TOTAL FACILITY ELEC ENERGY SAVED =  $\Sigma$  INDIVIDUAL TANKS

$$= \underline{\underline{2,496}} \frac{\text{MBTU ELEC}}{\text{YR.}}$$

LETTERKENNY ARMY DEPOT  
DIP TANK COVER  
SUMMARY

Building Number	Tank ID	Design Ventil. (cfm)	Common or Dedicated Fan (D)-(C)	Annual Value of FUEL(5% Saved (Mbtu)	Annual Value of Saved Energy (\$/yr)	Annual Value of Electric Saved (Mbtu)	Annual Value of Saved Ele Energy (\$/yr)	Total Cost Savings (\$/yr)	Const. Cost* (\$)	Payback (Yrs)	
+-----+											
1N	2861-1	10,000	D	1,137	\$5,014	109	\$1,192	\$6,207	\$9,148	1.5	
	2861-2	3,750	C	426	\$1,880	41	\$447	\$2,327	\$1,438	0.6	
	2861-3	7,500	C	853	\$3,761	82	\$894	\$4,655	\$1,438	0.3	
	2861-4	7,500	C	853	\$3,761	82	\$894	\$4,655	\$1,438	0.3	
	2861-5	7,500	C	853	\$3,761	82	\$894	\$4,655	\$1,438	0.3	
	+-----+										
	2861-6	7,500	D	853	\$3,761	82	\$894	\$4,655	\$9,148	2.0	
	2861-7	7,500	C	853	\$3,761	82	\$894	\$4,655	\$1,438	0.3	
	2861-8	7,500	C	853	\$3,761	82	\$894	\$4,655	\$1,438	0.3	
	+-----+										
	400	3,060	C	348	\$1,534	33	\$365	\$1,899	\$1,438	0.8	
	402	4,500	D	512	\$2,256	49	\$537	\$2,793	\$9,148	3.3	
	378	4,500	C	512	\$2,256	49	\$537	\$2,793	\$1,438	0.5	
	377	4,500	C	512	\$2,256	49	\$537	\$2,793	\$1,438	0.5	
4577	1,560	C	177	\$782	17	\$186	\$968	\$1,438	1.5		
4741	4,050	C	460	\$2,031	44	\$483	\$2,514	\$1,438	0.6		
+-----+											
Subtotal	1N	14	80,920	3	9,201	\$40,575	882	\$9,649	\$50,224	\$43,262	0.9
+-----+											
37	2568	6,800	D	773	\$3,410	74	\$811	\$4,221	\$9,148	2.2	
	4318	5,200	D	591	\$2,607	57	\$620	\$3,227	\$9,148	2.8	
	4319	9,600	D	1,092	\$4,814	105	\$1,145	\$5,958	\$9,148	1.5	
	4193	6,000	D	682	\$3,009	65	\$715	\$3,724	\$9,148	2.5	
+-----+											
Subtotal	37	4	27,600	4	3,138	\$13,839	301	\$3,291	\$17,130	\$36,592	2.1
+-----+											
350N	2514	9,360	D	1,064	\$4,693	102	\$1,116	\$5,809	\$9,148	1.6	
	2516	6,480	D	737	\$3,249	71	\$773	\$4,022	\$9,148	2.3	
	2518	9,360	D	1,064	\$4,693	102	\$1,116	\$5,809	\$9,148	1.6	
	2520	12,600	D	1,433	\$6,318	137	\$1,502	\$7,820	\$9,148	1.2	
	2744	5,500	D	625	\$2,758	60	\$656	\$3,414	\$9,148	2.7	
	1479	3,600	D	409	\$1,805	39	\$429	\$2,234	\$9,148	4.1	
	1480	6,860	D	780	\$3,440	75	\$818	\$4,258	\$9,148	2.1	
	2606	993	D	113	\$498	11	\$118	\$616	\$9,148	14.8	
	350S	2531	12,000	D	1,364	\$6,017	131	\$1,431	\$7,448	\$9,148	1.2
		2536	11,000	D	1,251	\$5,516	120	\$1,312	\$6,827	\$9,148	1.3
2539		2,500	D	284	\$1,254	27	\$298	\$1,552	\$9,148	5.9	
+-----+											
Subtotal	350	11	80,253	11	9,125	\$40,240	875	\$9,570	\$49,810	\$100,628	2.0



LETTERKENNY ARMY DEPOT  
DIP TANK COVER  
SUMMARY

Building Number	Tank ID	Design Ventil. (cfm)	Common or	Annual Value of	Annual Value of	Total	Const. Cost* (\$)	Payback (Yrs)			
			Dedicated Fan (D)-(C)	FUEL(5% Saved) (Mbtu)	Electric Saved (Mbtu)	Value of Saved Ele Energy (\$/yr)			Cost Savings (\$/yr)		
370	T-1	3,800	C	432	\$1,905	41	\$453	\$2,359	\$1,438	0.6	
	T-2	2,700	C	307	\$1,354	29	\$322	\$1,676	\$1,438	0.9	
	T-3	5,700	D	648	\$2,858	62	\$680	\$3,538	\$9,148	2.6	
	T-4	5,700	C	648	\$2,858	62	\$680	\$3,538	\$1,438	0.4	
	T-5	3,600	C	409	\$1,805	39	\$429	\$2,234	\$1,438	0.6	
	T-6	2,700	C	307	\$1,354	29	\$322	\$1,676	\$1,438	0.9	
	T-7	5,700	D	648	\$2,858	62	\$680	\$3,538	\$9,148	2.6	
	T-8	3,800	C	432	\$1,905	41	\$453	\$2,359	\$1,438	0.6	
	T-9	2,700	C	307	\$1,354	29	\$322	\$1,676	\$1,438	0.9	
	T-10	3,800	C	432	\$1,905	41	\$453	\$2,359	\$1,438	0.6	
Subtotal	370	10	40,200	2	4,571	\$20,157	438	\$4,794	\$24,951	\$29,800	1.2
Total	4	39	228,973	20	26,034	\$114,811	2,496	\$27,304	\$142,115	\$210,282	1.5

\* Costs for differential pressure controls and VF drives are not distributed over tanks sharing a common fan.

QRIP Calc using FY 92 Fuel Oil Prices

Current energy use:

$$E_{elec} = \text{Fan Hp} \times \text{Btu/Hp} \times 8760 \text{ hr/yr} \times \frac{1 \text{ MBtu}}{10^6 \text{ MBtu}} \times 10.94 \text{ \$/MBtu}$$

$$\begin{aligned} \text{Fan Hp} &= \frac{c_{fm} \Delta P}{6356 \eta_{fan}} \\ &= \frac{(228,973)(13)}{(6356)(0.5)} \times \frac{2545 \text{ Btu}}{\text{Hp hr}} \times \frac{8760}{10^6} \times 10.94 \text{ \$/MBtu} = \underline{\underline{\$52,700/\text{yr}}} \end{aligned}$$

$$\text{Fuel Oil} = c_{fm} \times \text{HLF} \div \eta_{blr} = 228,973 \times 0.166 \div 0.8 = 47,512 \text{ MBtu/yr}$$

$$\begin{aligned} \text{TOTAL COSTS} &= \underline{\underline{\$262,200/\text{yr}}} \\ &\quad 47,512 \times 4.41 \text{ \$/MBtu} = \underline{\underline{\$209,500/\text{yr}}} \end{aligned}$$

05/09/91

# ECO Construction Cost Estimate Calculations

ECO Name: Dip Tank Cover

ECO #: 3

1991 ECO "bare" costs (from cost estimate sheet)

Material	\$4,400
Labor	\$960

Subtotal bare costs	\$5,360
FICA Insurance (20% of Labor)	\$192
Sales Tax (6.5% of Material)	\$286

Subtotal	\$5,838
Overhead (15%)	\$876

Subtotal	\$6,714
Profit (10%)	\$671

Subtotal	\$7,385
Bond (1%)	\$74

Subtotal	\$7,459
Contingency (10%)	\$746

Subtotal (Construction Cost Input For LCCID *)	\$8,205
--	---------

SIOH (5.5% of Construction Cost)	\$451
----------------------------------	-------

Subtotal	\$8,656
Design (6% of Construction Cost)	\$492

Total Project Cost	\$9,148
--------------------	---------

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

05/09/91

# ECO Construction Cost Estimate Calculations

ECO Name: Dip Tank Covers w/o Controls

ECO #: 3

1991 ECO "bare" costs (from cost estimate sheet)

Material	\$500
Labor	\$320

Subtotal bare costs	\$820
---------------------	-------

FICA Insurance (20% of Labor)	\$64
-------------------------------	------

Sales Tax (6.5% of Material)	\$33
------------------------------	------

Subtotal	\$917
----------	-------

Overhead (15%)	\$138
----------------	-------

Subtotal	\$1,055
----------	---------

Profit (10%)	\$106
--------------	-------

Subtotal	\$1,161
----------	---------

Bond (1%)	\$12
-----------	------

Subtotal	\$1,173
----------	---------

Contingency (10%)	\$117
-------------------	-------

Subtotal (Construction Cost Input For LCCID *)	\$1,290
--	---------

SIOH (5.5% of Construction Cost)	\$71
----------------------------------	------

Subtotal	\$1,361
----------	---------

Design (6% of Construction Cost)	\$77
----------------------------------	------

Total Project Cost	\$1,438
--------------------	---------

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

09/26/91

# ECO Construction Cost Estimate Calculations

ECO Name: Dip Tank Covers

ECO #: 3

1991 ECO "bare" costs (from cost estimate sheet)

Material	\$97,500
Labor	\$25,280

Subtotal bare costs	\$122,780
FICA Insurance (20% of Labor)	\$5,056
Sales Tax (6.5% of Material)	\$6,338

Subtotal	\$134,174
Overhead (15%)	\$20,126

Subtotal	\$154,300
Profit (10%)	\$15,430

Subtotal	\$169,730
Bond (1%)	\$1,697

Subtotal	\$171,427
Contingency (10%)	\$17,143

Subtotal (Construction Cost Input For LCCID *)	\$188,570
--	-----------

SIOH (5.5% of Construction Cost)	\$10,371
----------------------------------	----------

Subtotal	\$198,941
Design (6% of Construction Cost)	\$11,314

Total Project Cost	\$210,255
--------------------	-----------

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

For QRIP - Tank cover costs

(p. 3-9)

Covers represent 26% of project cost  $\Rightarrow \frac{31930}{122,180} = 0.26$

Therefore  $210,257 \times 0.26 = \underline{\underline{\$54,765}}$



SUBJECT ECO #3  
\_\_\_\_\_  
DESIGNER P. Hutchins  
\_\_\_\_\_  
CHECKER \_\_\_\_\_

AEP NO 290-0379-001  
SHEET \_\_\_\_\_ OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

### Additional maintenance costs

Covers will last about 5 years

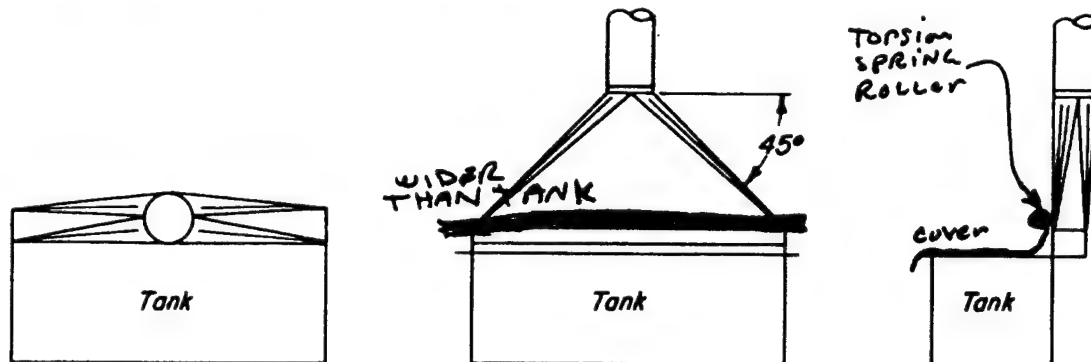
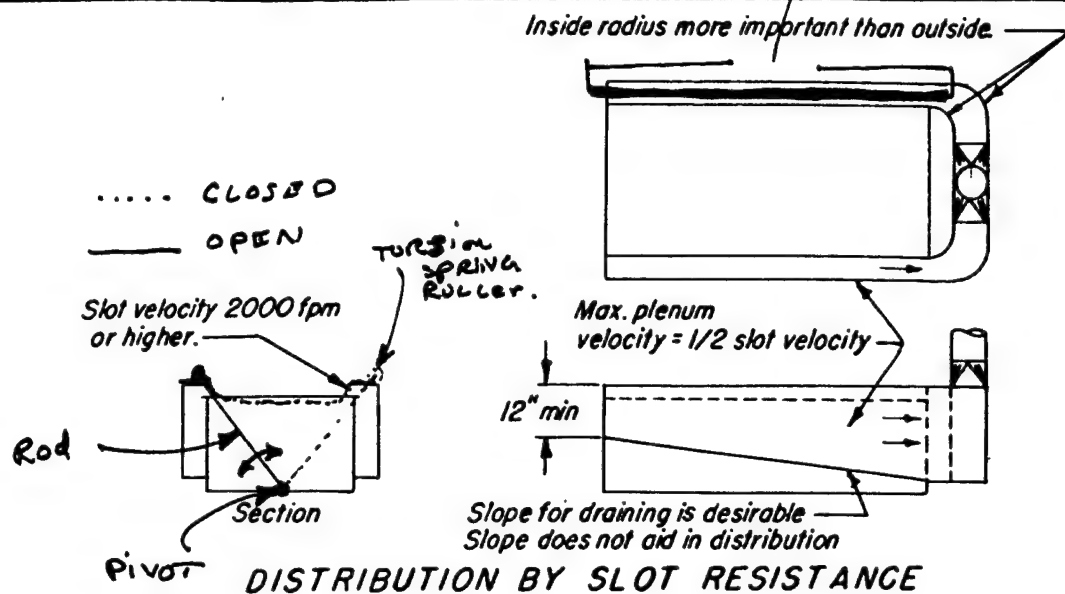
Therefore, covers will be replaced 3 times  
over the 15 year project life

For LCCID 1/5 of 39 covers will be replaced  
annually

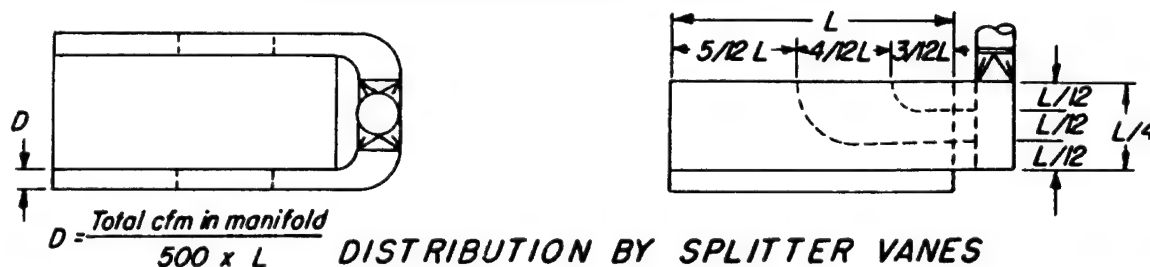
$$\frac{1}{5} \times \$600 \times 39 = \$4700$$



WIDER THAN TANK  
TO ALLOW OVERHANG



**DISTRIBUTION BY FISH TAIL**



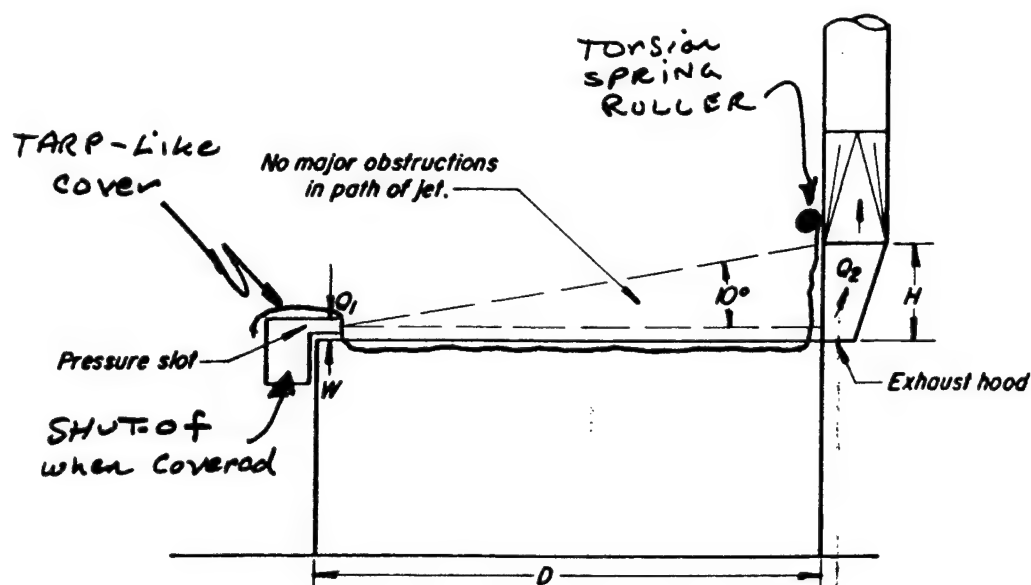
With low plenum velocities and high slot velocities, good distribution is obtained. If this design is not possible, splitter vanes should be used. Slots over 10 feet to 12 feet in length usually need multiple take-offs.

AMERICAN CONFERENCE OF  
GOVERNMENTAL INDUSTRIAL HYGIENISTS

**PRINCIPLES OF MANIFOLD DESIGN**

DATE 1-70

Fig. 4-12



## PUSH PULL HOODS

## Exhaust Hood

Quantity of air exhausted,  
 $Q_2 = 100$  to  $150$  cfm /sq. ft. of  
 tank area, depending on temp-  
 erature of liquid, cross drafts,  
 agitation, etc.

Hood height should be,  
 $H = D \times \tan 10^\circ$   
 $= 0.18D$

## Pressure Slot

Quantity of air supplied,

$$Q_1 = \frac{1}{D \times E} \times Q_2$$

where;  $D$  = length of throw, feet  
 $E$  = entrainment factor.

Throw length, $D$ , feet	Entrainment factor, $E$
0 - 8	2.0
8 - 16	1.4
16 - 24	1.0
over 24	0.7

Slot width  $W$  should be designed for  
 a velocity of 1000 to 2000 fpm.

Design such systems so they can be easily modified or adjusted to obtain desired results.

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 GOVERNMENTAL INDUSTRIAL HYGIENISTS

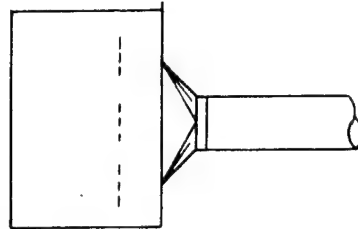
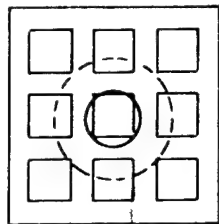
## HOOD DESIGN DATA

DATE

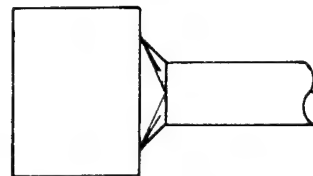
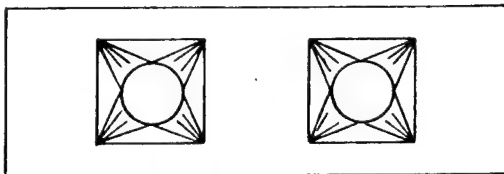
1-64

Fig. 4-17



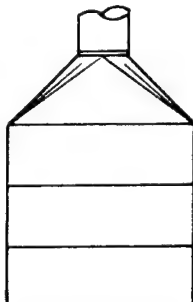


**DISTRIBUTION BY BAFFLES**  
See Fig. 4-16

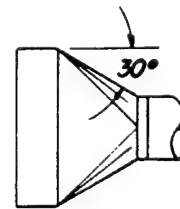
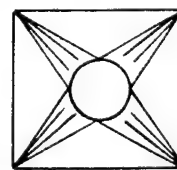


**LONG BOOTHS - DISTRIBUTION BY MULTIPLE TAKE-OFFS and TAPERS**

**BOOTH-TYPE HOODS**  
(Same principle apply to canopy type)



Slot velocity 2000 fpm or higher.



**DISTRIBUTION BY  
SPLITTER VANES**

**DISTRIBUTION BY  
SLOT (or baffles)**

**DISTRIBUTION BY TAPER**

**SIDE-DRAFT & SUSPENDED HOODS**

AMERICAN CONFERENCE OF  
GOVERNMENTAL INDUSTRIAL HYGIENISTS

**PRINCIPLES OF MANIFOLD DESIGN**

DATE 1-64

Fig. 4-13



THE KING OF  
TARPAULINS

GOSPORT MANUFACTURING COMPANY, INC.

DUNS: 04-598-0844  
TELEPHONE: 812/879-4224  
OUT OF STATE: 800/457-4406  
FAX: 812/879-4227

11 LOUISIA STREET, P.O. BOX #26, GOSPORT, INDIANA 47433

March 15, 1991

REYNOLDS, SMITH & HILLS  
4651 SALISBURY ROAD  
JACKSONVILLE, FL 32256  
ATTN: GEORGE FALLEN

Dear George:

Please find the information that I have enclosed for you per our recent phone conversation.

You can be assured that Gosport Manufacturing Company will provide you with the best in quality and excellent service in meeting your tarpaulin needs. Not only do we offer quality, 100% American made products, we stand behind everything we make.

If I can be of any service, or if you have any questions, please do not hesitate to call me at 800-457-4406. Thank you for your consideration!

Looking forward to doing business with you!

Sincerely,

David S. Daubenhey  
Account Executive

DSD/mg

Enclosures

# TARPAULINS

# COVERS

NAME	CATALOG PAGE	ORDER NUMBER	WEIGHT	DESCRIPTION	COLOR	PRICE (per sq. ft.)
<b>CANVAS TARPS*</b>						
Noble	4	TCN08	8 oz.	1 1/2" hem	Drab, Brown	244
Noble	4	TCN10	10 oz.	1 1/2" hem	Drab, Brown	254
Noble	4	TCN12	12 oz.	1 1/2" hem	Drab, Brown	274
Noble	4	TCN15	14.9 oz.	1 1/2" hem	Drab, Brown	274
Royal	3	TCR08	8 oz.	Reinforced patches, brass grommets	Drab, Brown	254
Royal	3	TCR10	10 oz.	Reinforced patches, brass grommets	Drab, Brown	264
Royal	3	TCR12	12 oz.	Reinforced patches, brass grommets	Drab, Brown	284
Royal	3	TCR15	14.9 oz.	Reinforced patches, brass grommets	Drab, Brown	284
Majestic	4	TCM08	8 oz.	Rope-in-hem, two rows of stitching	Drab, Brown	254
Majestic	4	TCM10	10 oz.	Rope-in-hem, two rows of stitching	Drab, Brown	264
Majestic	4	TCM12	12 oz.	Rope-in-hem, two rows of stitching	Drab, Brown	284
Majestic	4	TCM15	14.9 oz.	Rope-in-hem, two rows of stitching	Drab, Brown	284
Royal	3	TCR08	8 oz.	D-rings, reinforced patches, rope-in-hem	Drab, Brown	264
Royal	3	TCR10	10 oz.	D-rings, reinforced patches, rope-in-hem	Drab, Brown	274
Royal	3	TCR12	12 oz.	D-rings, reinforced patches, rope-in-hem	Drab, Brown	294
Royal	3	TCR15	14.9 oz.	D-rings, reinforced patches, rope-in-hem	Drab, Brown	294

<b>VINYL TARPS</b>						
Neoprene	5	TVN16	16 oz.	Extra durable material	Black	374
Laminated	5	TVL10	10 oz.	Flame resistant	White/Black	344
Coated	5	TVL14	14 oz.	Flame resistant treated	Grn, Red, Blu	404
Coated	5	TVL18	18 oz.	Tear and puncture resistant	Large variety	474
Coated	5	TVL22	22 oz.	Tear and puncture resistant	Large variety	524

<b>POLYETHYLENE TARPS</b>						
Unreinforced	6	TPU		D-rings, reinforced patches, rope-in-hem	Blue	194
AB-American	6	TFA		Rope-in-hem, two rows of stitching (Orders less than \$100, 9.5¢ per sq. ft.)	Blue	6.54
Poly Tarp	10	TP8FR		8 x 9, flame resistant	Opaque	144
Poly Tarp	10	TP10Q4		10 x 10	White/White	94
Poly Tarp	10	TP1212		12 x 12	Black/White	194
Poly Tarp	10	TP8UV		8 x 9, UV resistant	White/White	134
Poly Tarp	10	TP81010		10 x 10	Silver	134

<b>INFLATION FIGHTER TARPS</b>						
	9	TIF10	10 oz.	Made from piece goods, fabric varies	Varies	224
	9	TIF12	12 oz.	Made from piece goods, fabric varies	Varies	23.94

<b>DRY FINISH TARPS</b>						
	9	TDF10	10 oz.	No rub off or discoloration damage	Pearl B	264
	9	TDF103	10.3 oz.	Army Duck, no rub off damage	Pearl B	374

## COVERS

NAME	CATALOG PAGE	ORDER NUMBER	WEIGHT	DESCRIPTION	COLOR	PRICE (per sq. ft.)
<b>SWIMMING POOL COVERS</b>						
Royal	9	CVPR10	10 oz.	Vinyl laminated, reinforced patches & webbing	Grn, Red, Blu	374
Royal	9	CVPR14	14 oz.	Vinyl laminated, reinforced patches & webbing	Grn, Red, Blu	444
American	9	CPPAL		Light weight poly, reinforced patches & webbing	Blue	134
American	9	CPPALH		Heavy weight poly, reinforced patches & webbing	Blue	234
Net	9	CHP		Reinforced patches & webbing	Multi-color	244

\*Commercial Canvas Flame Resistant, add 5¢ per square foot.

NAME	CATALOG PAGE	ORDER NUMBER	WEIGHT	DESCRIPTION	COLOR	PRICE (per sq. ft.)
CAR COVERS						
A	11	CDC-A		Poly-cotton blend, elastic & tie downs	Pearl Green	164.99 net
B	11	CDC-B		Poly-cotton blend, elastic & tie downs	Pearl Green	161.99 net
C	11	CDC-C		Poly-cotton blend, elastic & tie downs	Pearl Green	167.99 net
D	11	CDC-D		Poly-cotton blend, elastic & tie downs	Pearl Green	172.99 net
E	11	CDC-E		Poly-cotton blend, elastic & tie downs	Pearl Green	177.99 net
F	11	CDC-F		Poly-cotton blend, elastic & tie downs	Pearl Green	164.99 net
Bag	11	MC8B		Car cover storage bag	Pearl Green	13.95 net
TRUCK COVERS						
Net	6	CNTT		Top grade PVC coated poly net, 2" hems	Grn, Blu, Blk Multi-color	244
Net	6	CNTE		Economy grade, 1 1/2" hem	Varies	206
Steel Hauler	6	CCM12	12 oz.	Cotton Duck, D-rings set into save bands	Drab, Brown	344
Steel Hauler	6	CCM15	14.9 oz.	Cotton Duck, D-rings set into save bands	Drab, Brown	444
Steel Hauler	6	CVH18	18 oz.	Vinyl coated nylon, D-rings set into save bands	Large variety	626
GYM COVERS						
Canvas	13	CCG10	10 oz.	Flame resistant, meets state school fire codes	Tan	Quote
Vinyl	13	CVG10	10 oz.	Completely waterproof & flame resistant Meets state school fire codes	Large variety	Quote

# Telephone Call Confirmation

Project No. \_\_\_\_\_

reynolds, smith and hills

Local \_\_\_\_\_ L.D. X Placed \_\_\_\_\_ Rec'd X Date 3-21-91  
G. FALLON S.M.F. Conversed with BOB FINK (717) 782-3902  
Of OSHA HARRISBURG, PA. Regarding DIP TANK COVERS.

G.F. EXPLAINED FLEXIBLE DIP TANK COVERS WITH FAN  
AP CONTROLS.

B.F. ADVISED THAT OSHA HAS VERY SPECIFIC REGULATIONS  
RE: MINIMUM DIP TANK AIR FLOW REQUIREMENTS AIMED  
AT PROTECTING WORKERS FROM ON THE JOB HAZARDS.

ALTHOUGH REDUCING THE AIR FLOW WOULD BE A  
"TECHNICAL" VIOLATION, NO CITATION WOULD BE ISSUED  
AS LONG AS THERE WAS NO HAZARD TO THE WORKER.

HE FELT THAT AS LONG AS THE FANS WERE  
DRAWING AIR FROM THE CAVITY BETWEEN THE  
COVER AND THE FLUID THAT ANY EVOLVED FUMES  
WOULD STILL BE EXHAUSTED.

NOTE: MR FINK ADVISED THAT DIP TANK VENT FANS  
SHOULD BE OPERATED AT ALL TIMES (24 HRS/day)  
AS A GENERAL RULE. THIS WAS ECHOED BY  
LEAD HYGIENISTS.

Distribution:

ECO # 5

EMCS For Building 370

Assumptions:

1. This ECO will use the calculations and cost estimates of the Brinjac, Kambic and Associates 1-16-89 report; Energy Monitoring and Control System Study, Phase II Submission.
2. The energy costs will be updated to reflect the current values.
3. The capital cost estimates will be escalated based on ENR Construction Cost Index history.

BK & A Data:

$$\text{Electricity Cost} = \$0.06/\text{kwh} = \$17.58/\text{MBtu}$$

$$\text{Fuel Oil \#6 Cost} = \$0.70/\text{gal} \times \frac{1\text{gal}}{0.150\text{ MBtu}} = \$4.67/\text{MBtu}$$

Current Data:

$$\text{Electricity Cost} = \$0.0373/\text{kwh} = \$10.94/\text{MBtu}$$

$$\text{Fuel Oil \#6 Cost} = \$0.99/\text{gal} \times \frac{1\text{gal}}{0.14969\text{ MBtu}} = \$6.61/\text{MBtu}$$

Only the total energy cost savings are shown on the EMCS Programs Summary sheets. The programs with acceptable pay backs are:

- (1) Scheduled start/stop (SSS)
- (4) Day/Night Temperature Setback (DNS)
- (6) LEAD Modified Economizer (LME)
- (9) Reheat Coil Reset (RR)

The start/stop, day/night setback and reheat reset programs save both heating (fuel oil #5) energy and cooling (Electricity) energy. The LEAD modified economizer saves cooling energy (Electricity)

Since only the total energy savings are given, the following calculations will split out the two types of energy saved so the current values can be applied.

From the BKEA Input Data:

Winter set point = 68°F

Summer set point = 75°F

Winter avg. temp. = 42.7°F

Summer avg. temp. = 80°F

Weeks of winter = 26.9

Weeks of summer = 25.1

Since the weeks of winter is approximately equal to the weeks of summer, it is assumed that the temperature differences will be the driving force for the energy savings.

$$\text{Winter } \Delta T = 68^{\circ}\text{F} - 42.7^{\circ}\text{F} = 25.3^{\circ}\text{F}$$

$$\text{Summer } \Delta T = 80^{\circ}\text{F} - 75^{\circ}\text{F} = 5^{\circ}\text{F}$$

assume a sensible heat ratio of 0.75 so the "effective" summer  $\Delta T = 5 \div 0.75 = 6.7^{\circ}\text{F}$

The total energy saved (summer & winter) is represented by:

$$\text{Total } \Delta T = 25.3 + 6.7 = 32$$

Fuel Oil (winter)

$$\frac{25.3}{32} = 0.79 \Rightarrow 79\% \text{ of the annual energy savings is fuel oil}$$

Electricity (Summer)

$$\frac{6.7}{32} = 0.21 \Rightarrow 21\% \text{ of the annual energy savings is electricity}$$

The relative portions of the given annual cost savings are:

$$0.79 \times \text{Total MBtu} \times \$4.67/\text{MBtu} = \text{Fuel oil cost savings}$$

$$0.21 \times \text{Total MBtu} \times \$17.58/\text{MBtu} = \text{Electric cost savings}$$

$$\text{Total cost savings} = \text{Fuel oil savings} + \text{Electric savings}$$

For one MBtu saved:

$$\text{Total cost savings} = 0.79 \times 1 \text{ MBtu} \times 4.67 \frac{\$}{\text{MBtu}} + 0.21 \times 1 \text{ MBtu} \times 17.58 \frac{\$}{\text{MBtu}}$$

$$\text{Total Cost Savings} = \$3.69 (\text{Fuel oil}) + \$3.69 (\text{Elec})$$

This means the total cost savings is made up of 50% fuel oil cost savings and 50% electrical cost savings.

To update the energy cost savings:

$$\text{Electricity: } \$10.94/\text{MBtu} \div \$17.58/\text{MBtu} = 0.62 \frac{\text{Current } \$/\text{MBtu}}{\text{BKA } \$/\text{MBtu}}$$

$$\text{Fuel Oil } \#6: \$6.61/\text{MBtu} \div \$4.67/\text{MBtu} = 1.45 \frac{\text{Current } \$/\text{MBtu}}{\text{BKA } \$/\text{MBtu}}$$

The original energy cost savings from the BKA report are shown on the spreadsheet titled "Building 370 EMCS - From BKA Report."

The new updated energy cost savings are shown on the spreadsheet titled "Building 370 EMCS - Update."

$$\text{Total energy cost savings} = \underline{\$72,087/\text{year}}$$

$$\text{Total capital cost} = \underline{\$182,447} \quad (\text{See cost estimate sheets for details})$$

$$\text{Simple Payback} = \text{Cost} \div \text{Savings} = \$182,447 / \$72,087/\text{yr}$$

$$\text{Payback} = \underline{2.5 \text{ years}}$$



Letterkenny Army Depot  
Building 370 EMCS - From BK&A Report

Apr-91

System	Equip.	Critical Area	O.A. Cap.	Shifts	SSS 1	DNS 4	LME 6	RR 9	Totals
2	AHU	No	100%	1	4642		991	1353	6986
3	AHU	No	100%	1	3554		2138	2920	8612
4	AHU	No	100%	1	549		2138		2687
8	AHU	Yes	Min	2		407			407
9	AHU	No	Min	1	403				403
19	AHU	No	Min	1	403				403
27	AHU	No	100%	1	4670		2138	2920	9728
28	AHU	No	100%	1	2544		991	1353	4888
29	AHU	No	100%	1	1195				1195
30	AHU	No	100%	1	4830				4830
31	AHU	No	100%	1	4444		1739	2375	8558
32	AHU	No	100%	1	4257		2138	2920	9315
370a	AHU	No	100%	1	4079		2138	2920	9137
370b	AHU	No	100%	1	4079		2138	2920	9137
Total Annual Energy Cost Savings					39649	407	16549	19681	76286
Capital Cost Per Controlled System					1653	1653	4233	4249	
Total Capital Cost					21489	1653	38097	33992	95231
Simple Payback - Years					0.54	4.06	2.30	1.73	1.25

AHU - Air handling unit  
 SSS - Scheduled start/stop  
 DNS - Day/night temperature setback  
 LME - LEAD modified dry bulb economizer  
 RR - Reheat coil reset

Letterkenny Army Depot  
Building 370 EMCS - Update Summary

Apr-91

System	Equip.	Critical Area	O.A. Cap.	Shifts	SSS 1	DNS 4	LME 6	RR 9	Totals
2	AHU	No	100%	1	4801		617	1399	6818
3	AHU	No	100%	1	3676		1330	3020	8027
4	AHU	No	100%	1	568		1330		1898
8	AHU	Yes	Min	2		421			421
9	AHU	No	Min	1	417				417
19	AHU	No	Min	1	417				417
27	AHU	No	100%	1	4830		1330	3020	9181
28	AHU	No	100%	1	2631		617	1399	4648
29	AHU	No	100%	1	1236				1236
30	AHU	No	100%	1	4996				4996
31	AHU	No	100%	1	4597		1082	2457	8135
32	AHU	No	100%	1	4403		1330	3020	8754
370a	AHU	No	100%	1	4219		1330	3020	8570
370b	AHU	No	100%	1	4219		1330	3020	8570
Total Annual Energy Cost Savings					41011	421	10298	20357	72087
Capital Cost Per Controlled System					1703	1703	4360	4376	

AHU - Air handling unit  
SSS - Scheduled start/stop  
DNS - Day/night temperature setback  
LME - LEAD modified dry bulb economizer  
RR - Reheat coil reset

Calculations:

Equipment Capital Cost = BK&A Capital Cost x 2716 / 2639  
= BK&A Capital Cost x 1.03

For LME Program:

Electric Cost Savings = BK&A Total Savings x 10.94 / 17.58  
= BK&A Total Savings x 0.62

For SSS, DNS and RR Programs:

Electric Cost Savings = BK&A Total Savings x 0.5 x 10.94 / 17.58  
= BK&A Total Savings x 0.31

Fuel Oil Cost Savings = BK&A Total Savings x 0.5 x 6.61 / 4.67  
= BK&A Total Savings x 0.72

Total Cost Savings = Electric Cost Savings + Fuel Oil Cost Savings

Letterkenny Army Depot  
Building 370 EMCS - Update

Apr-91

### Electricity Cost Savings

System	Equip.	Critical Area	O.A. Cap.	Shifts	SSS 1	DNS 4	LME 6	RR 9	Totals
2	AHU	No	100%	1	1444		617	421	2482
3	AHU	No	100%	1	1106		1330	909	3345
4	AHU	No	100%	1	171		1330		1501
8	AHU	Yes	Min	2		127			127
9	AHU	No	Min	1	125				125
19	AHU	No	Min	1	125				125
27	AHU	No	100%	1	1453		1330	909	3692
28	AHU	No	100%	1	792		617	421	1829
29	AHU	No	100%	1	372				372
30	AHU	No	100%	1	1503				1503
31	AHU	No	100%	1	1383		1082	739	3204
32	AHU	No	100%	1	1325		1330	909	3564
370a	AHU	No	100%	1	1269		1330	909	3508
370b	AHU	No	100%	1	1269		1330	909	3508
Total Annual Electric Cost Savings					12337	127	10298	6124	28886

### Fuel Oil #5 Cost Savings

System	Equip.	Critical Area	O.A. Cap.	Shifts	SSS 1	DNS 4	LME 6	RR 9	Totals
2	AHU	No	100%	1	3357		0	978	4336
3	AHU	No	100%	1	2570		0	2112	4682
4	AHU	No	100%	1	397		0		397
8	AHU	Yes	Min	2		294			294
9	AHU	No	Min	1	291				291
19	AHU	No	Min	1	291				291
27	AHU	No	100%	1	3377		0	2112	5489
28	AHU	No	100%	1	1840		0	978	2818
29	AHU	No	100%	1	864				864
30	AHU	No	100%	1	3493				3493
31	AHU	No	100%	1	3214		0	1718	4931
32	AHU	No	100%	1	3079		0	2112	5190
370a	AHU	No	100%	1	2950		0	2112	5062
370b	AHU	No	100%	1	2950		0	2112	5062
Total Annual Fuel Oil Cost Savings					28674	294	0	14233	43201

### Electric Cost Savings:

For LME Program = BK&A Total Savings x 10.94 / 17.58  
= BK&A Total Savings x 0.62

For SSS, DNS & RR = BK&A Total Savings x 0.5 x 10.94 / 17.58  
= BK&A Total Savings x 0.31

Fuel Oil Cost Savings = BK&A Total Savings x 0.5 x 6.61 / 4.67  
= BK&A Total Savings x 0.72

Letterkenny Army Depot  
Building 370 EMCS - Update

Apr-91

### Electric Energy Savings

System	Equip.	Critical Area	O.A. Cap.	Shifts	SSS 1	DNS 4	LME 6	RR 9	Totals
2	AHU	No	100%	1	132		56	38	227
3	AHU	No	100%	1	101		122	83	306
4	AHU	No	100%	1	16		122		137
8	AHU	Yes	Min	2		12			12
9	AHU	No	Min	1	11				11
19	AHU	No	Min	1	11				11
27	AHU	No	100%	1	133		122	83	337
28	AHU	No	100%	1	72		56	38	167
29	AHU	No	100%	1	34				34
30	AHU	No	100%	1	137				137
31	AHU	No	100%	1	126		99	68	293
32	AHU	No	100%	1	121		122	83	326
370a	AHU	No	100%	1	116		122	83	321
370b	AHU	No	100%	1	116		122	83	321

Annual Electricity Savings, MBtu/Yr      1128      12      941      560      2640

### Fuel Oil #5 Energy Savings

System	Equip.	Critical Area	O.A. Cap.	Shifts	SSS 1	DNS 4	LME 6	RR 9	Totals
2	AHU	No	100%	1	508		0	148	656
3	AHU	No	100%	1	389		0	319	708
4	AHU	No	100%	1	60		0		60
8	AHU	Yes	Min	2		45			45
9	AHU	No	Min	1	44				44
19	AHU	No	Min	1	44				44
27	AHU	No	100%	1	511		0	319	830
28	AHU	No	100%	1	278		0	148	426
29	AHU	No	100%	1	131				131
30	AHU	No	100%	1	528				528
31	AHU	No	100%	1	486		0	260	746
32	AHU	No	100%	1	466		0	319	785
370a	AHU	No	100%	1	446		0	319	766
370b	AHU	No	100%	1	446		0	319	766

Annual Fuel Oil Savings, MBtu/Yr      4338      45      0      2153      6536

Electric Energy Savings = Electric cost savings / \$10.94/MBtu

Fuel Oil Energy Savings = Fuel Oil Cost Savings / \$6.61/MBtu

## BK&amp;A EMCS Study

Input Data

## REQUIRED INPUTS/CALCULATIONS FOR EMCS CALCULATIONS

	LEAD	B-370
ELECTRIC (\$/KWH):	0.06	0.06
BTU/KWH:	3413	3413
FUEL OIL (\$/GAL):	0.60	0.70
BTU/GAL (HV):	137,000	150,000
KW/TON (CPT):	1.25	1.25
HEATING EFF (HEFF):	60 %	50 %

WINTER DESIGN O/A :	8	*F
SUMMER DESIGN O/A :	90	*F
WINTER SET POINT (WSP) :	68	*F
SUMMER SET POINT (SSP) :	75	*F
LOW TEMP LIMIT (LTL) :	50	*F

PERCENT O/A (POA):	0.1	
THERMOSTAT SET-UP (SU):	15	*F
THERMOSTAT SET-DOWN (SD):	15	*F

LOAD FACTOR (L): 80 %

PRESENT WARM-UP TIME (WH): 2 HR(S)  
PRESENT COOL-DOWN TIME (CH): 2 HR(S)

HEATING DEGREE DAYS (HDD): 5519 (FOR LEAD)

REHEAT SYSTEM RESET (RHR) : 3 \*F

COOLING FULL LOAD HOURS (CFLH) : 1100 HRS (PITT, PA)

PRESENT CONDENSER WATER TEMP: 85 \*F

HOURS OPERATION / WEEK (OP SCH #2): 168 HR/WK

HOURS OPERATION / WEEK (OP SCH #1): 78 HR/WK

LIGHTING LEVEL (WATTS/FT2): 3 (W/FT2)

AVERAGE O/A WET BULB: 68.3 \*F  
AVERAGE O/A ENTHALPY (OAH): 32.6 BTU/LB  
R/A ENTHALPY (RAH): 29.9 BTU/LB

TOTAL WEEKS OF WINTER (WKW): 26.9 WEEKS  
TOTAL WEEKS OF SUMMER (WKS): 25.1 WEEKS

AVERAGE WINTER TEMPERATURE (AWT): 42.7 \*F  
AVERAGE SUMMER TEMPERATURE (AST): 90.0 \*F

DAYS REQ'D WARM-UP (AND) : 250.6 DAYS/YEAR

EQUIPMENT RUN TIME (ERT): 280 HOURS/YEAR  
7

ECONOMIZER HOURS :  
CRITICAL BLDGS(50°-55°)0800-1700: 200 HOURS/YR  
NON-CRITICAL BLDGS(50°-55°)0800-1700: 200 HOURS/YR

AVERAGE CONDENSER WATER TEMP (ACWT): 73.9 F  
REDUCTION OF CONDENSER TEMP (RCWT): 11.1 \*F

HEATING FULL LOAD HOURS (HFLH): 36,167 DEG-HRS

LEAD MODIFIED ECONOMIZER HOURS:  
CRITICAL BLDGS(50-60 DEG)0800-1700HRS 397  
NON-CRITICAL BLDGS(50-60 DEG)0800-1700HR 397

LETTERVENNY ARMY DEPOT  
ENERGY MONITORING AND CONTROL SYSTEM STUDY  
FY88, OMA, PW262

BUILLONG MO. 370

## II: OPERATING SCHEDULE

1  
2

# POTENTIAL ENCS PROGRAMS

SYSTEM	TYPE	SYS	GIVEN	OPERATING	CAPACITY	(BTU/HR)	FAM	FAM	HP	S	S	(1)	(2)	(3)	(4)	(5)			
			INFO	SCHEDULE	HEATING	COOLING	CFM			S / S	PERIOD	SCHEDULED	PAYBACK	DUTY	PAYBACK	DAY/NIGHT	PAYBACK	DRY HULB	PAYBACK
										S / S	PERIOD	S / S	PERIOD	CYCLING	PERIOD	SETBACK	PERIOD	ECONO.	PERIOD
001	2	2	2	2	0	1956000	0					40	ERR	40	ERR	40	ERR	40	ERR
002	5	7	1	223100	470770	14006	23	44,642	0.36			8257	3.90	8471	3.51	40	ERR	4499	7.53
003	5	7	1	350520	542745	31500	15	81,554	0.47			8168	5.98	8307	5.38	40	ERR	81,077	3.49
004	5	7	1	0	219660	31500	15	4549	3.01			8168	5.98	8307	5.38	40	ERR	81,077	3.49
005	5	7	1	112450	84625	1680	1.5	40	ERR			817	59.82	831	53.80	40	ERR	60	ERR
006	4	2	2	0	36000	1449	0.5	40	ERR			86	179.46	826	43.41	40	ERR	40	ERR
009	6	2	1	187826	60000	2415	1	4403	4.10			811	89.73	820	80.70	40	ERR	60	ERR
019	6	2	1	187826	60000	2415	1	4403	4.10			811	89.73	820	80.70	40	ERR	60	ERR
021	6	2	1	187826	60000	2415	1	40	ERR			811	89.73	820	80.70	40	ERR	60	ERR
026	2	2	2	0	3000000	0	0					40	ERR	40	ERR	40	ERR	40	ERR
027	5	7	1	118460	795850	31500	15	44,670	0.35			8168	5.98	8307	5.38	40	ERR	81,077	3.49
028	5	7	1	188100	219720	14600	23	82,544	0.65			8257	3.90	8471	3.51	40	ERR	4499	7.53
029	5	7	1	205430	658940	2840	2	61,195	1.38			822	44.87	841	40.35	40	ERR	60	ERR
030	5	7	1	100730	281970	1680	1.5	44,830	0.34			817	59.82	831	53.80	40	ERR	40	ERR
031	5	7	1	204330	634600	25420	15	44,444	0.37			8168	5.98	8307	5.38	40	ERR	8876	4.29
032	5	7	1	470910	408870	31500	15	44,257	0.39			8168	5.98	8307	5.38	40	ERR	81,077	3.49
376-A	5	7	1	155000	429750	31500	15	44,079	0.41			8168	5.98	8307	5.38	40	ERR	81,077	3.49
376-B	5	7	1	182970	375300	31500	15	44,079	0.41			8168	5.98	8307	5.38	40	ERR	81,077	3.49

LETTERKEMMY ARMY DEPOT  
ENERGY MONITORING AND CONTROL SYSTEM STUDY  
FY88, DWA, PW262

BUILDING NO. 370

POTENTIAL E M C S PROGRAMS

(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	SYSTEM
FILEAM NO. PAYBACK VENT. & PAYBACK H/C DECK PAYBACK REHEAT PAYBACK I.H.M. D/A PAYBACK CHM PAYBACK COND MTR PAYBACK BOILER PAYBACK	PERIOD RECIRC. PERIOD ITTEMP RESET PERIOD RESET PERIOD RESET PERIOD RESET PERIOD RESET PERIOD RESET PERIOD RESET PERIOD RESET PERIOD							
40	ERR	40	ERR	40	ERR	40	ERR	001
40	ERR	40	ERR	40	ERR	40	ERR	002
40	ERR	40	ERR	40	ERR	40	ERR	003
40	ERR	40	ERR	40	ERR	40	ERR	004
40	ERR	40	ERR	40	ERR	40	ERR	005
40	ERR	40	ERR	40	ERR	40	ERR	008
40	ERR	40	ERR	40	ERR	40	ERR	009
40	ERR	40	ERR	40	ERR	40	ERR	019
40	ERR	40	ERR	40	ERR	40	ERR	021
40	ERR	40	ERR	40	ERR	40	ERR	026
40	ERR	40	ERR	40	ERR	40	ERR	027
40	ERR	40	ERR	40	ERR	40	ERR	028
40	ERR	40	ERR	40	ERR	40	ERR	029
40	ERR	40	ERR	40	ERR	40	ERR	030
40	ERR	40	ERR	40	ERR	40	ERR	031
40	ERR	40	ERR	40	ERR	40	ERR	032
40	ERR	40	ERR	40	ERR	40	ERR	370-A
40	ERR	40	ERR	40	ERR	40	ERR	370-B

LETTERKENNY ARMY DEPOT  
ENERGY MONITORING AND CONTROL SYSTEM STUDY  
FY88, OMA, PN262

Building No. 370 EMCS Program Listing (< 3 year Payback).

<u>Program</u>	<u>System</u>	<u>Annual Savings</u>	<u>Payback</u>
Schedule S/S	002	\$4,642.00	.36
	003	3,554.00	.47
	027	4,670.00	.35
	028	2,544.00	.65
	029	1,195.00	1.38
	030	4,830.00	.34
	031	4,440.00	.37
	370-A	4,079.00	.41
LEAD Mod. Economizer	003	\$2,138.00	1.98
	004	2,138.00	1.98
	027	2,138.00	1.98
	031	1,739.00	2.43
	032	2,138.00	1.98
	370-A	2,138.00	1.98
	370-B	2,138.00	1.98
Reheat Reset	003	\$2,920.00	1.46
	027	2,920.00	1.46
	031	2,375.00	1.79
	032	2,920.00	1.46
	370-A	2,920.00	1.46
	370-B	2,920.00	1.46

Total Building No. 370 Annual Potential Savings: \$65,757.00

(EMCS Programs < 3 year Payback)



05/14/91

ECO Construction Cost Estimate  
Calculations

ECO Name: EMCS For Building 370

ECO #: 5

1991 ECO "bare" costs (from cost estimate sheet)

Material	\$62,256
Labor	\$41,771

Subtotal bare costs	\$104,027
FICA Insurance (20% of Labor)	\$8,354
Sales Tax (6.5% of Material)	\$4,047

Subtotal	\$116,428
Overhead (15%)	\$17,464

Subtotal	\$133,892
Profit (10%)	\$13,389

Subtotal	\$147,281
Bond (1%)	\$1,473

Subtotal	\$148,754
Contingency (10%)	\$14,875

Subtotal (Construction Cost Input For LCCID *)	\$163,629
--	-----------

SIOH (5.5% of Construction Cost)	\$9,000
----------------------------------	---------

Subtotal	\$172,629
Design (6% of Construction Cost)	\$9,818

Total Project Cost	\$182,447
--------------------	-----------

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.



# COST ESTIMATE BACK-UP

ECO #5

## LEAD EMCS PROGRAM COST ESTIMATES

EMCS Program: SCHEDULED START/STOP

### I/O Requirements

Digital Inputs - Equipment status

Analog Inputs - Space dry bulb temperature

Digital Outputs - on/off control relay

### Cost Estimate:

	<u>Material</u> <u>Cost</u>	<u>Labor</u> <u>MH</u>	<u>Labor</u> <u>Costs</u>	<u>Total</u> <u>Costs</u>
<u>DIGITAL INPUT FUNCTIONS:</u>				
1. Differential Pressure (Air)				
(e.g., fan status):				
Air DP Switch	70	1.9 (SM)	44	114
DI Common Costs	<u>139</u>	<u>8.4 (E)</u>	<u>193</u>	<u>332</u>
Totals	209	8.4(E)+1.9(SM)	237	446

### ANALOG INPUT FUNCTIONS:

1. Space Temperature	125	1.4 (E)	32	157
RTD and Transmitter	<u>210</u>	<u>9.4 (E)</u>	<u>216</u>	<u>426</u>
AI Common Costs	335	10.8 (E)	248	583

### DIGITAL OUTPUT FUNCTIONS:

1. Controller Override				
(e.g., Economizer Switchover)				
Control Relay	19	1.0 (E)	23	42
EP Valve	190	1.0 (P)	23	213
Pressure Regulator	25	0.5 (P)	12	37
DO Common Costs	<u>139</u>	<u>8.4 (E)</u>	<u>193</u>	<u>332</u>
Totals	373	1.5(P)+9.4(E)	251	624

SCHEDULED START/STOP Total Estimated Cost \$1,653.00

Totals \$917 \$736 \$1653

## LEAD EMCS PROGRAM COST ESTIMATES

EMCS Program: DAY/NIGHT SETBACK

I/O Requirements

Digital Inputs - Equipment status

Analog Inputs - Space dry bulb temperature

Digital Outputs - on/off control relay

Cost Estimate:

	<u>Material Cost</u>	<u>Labor MH</u>	<u>Labor Costs</u>	<u>Total Costs</u>
<u>ANALOG INPUT FUNCTIONS:</u>				
1. Space Temperature:				
RTD and Transmitter	125	1.4 (E)	32	157
AI Common Costs	<u>210</u>	<u>9.4 (E)</u>	<u>216</u>	<u>426</u>
Totals	335	10.8 (E)	248	583

DIGITAL INPUT FUNCTIONS:

1. Differential Pressure (Air)				
(e.g., fan status):				
Air DP Switch	70	1.9 (SM)	44	114
DI Common Costs	<u>139</u>	<u>8.4 (E)</u>	<u>193</u>	<u>332</u>
Totals	209	8.4(E)+1.9(SM)	237	446

DIGITAL OUTPUT FUNCTIONS:

1. Controller Override				
Control Relay	19	1.0 (E)	23	42
EP Valve	190	1.0 (P)	23	213
Pressure Regulator	25	0.5 (P)	12	37
DO Common Costs	<u>139</u>	<u>8.4 (E)</u>	<u>193</u>	<u>332</u>
Totals	373	1.5(P)+9.4(E)	251	624

DAY/NIGHT SETBACK Total Estimated Cost \$1,653.00

Totals \$917 \$736 \$1653

## LEAD EMCS PROGRAM COST ESTIMATES

EMCS Program: LEAD MODIFIED ECONOMIZER

I/O Requirements

Digital Inputs - Humidity high limit

Analog Inputs - O/A damper position  
 O/A dry bulb temperature  
 Mixed Air Temperature.

Analog Outputs - Auto/minimum open  
 O/A damper control

Cost Estimate:

	<u>Material Cost</u>	<u>Labor MH</u>	<u>Labor Costs</u>	<u>Total Costs</u>
<u>DIGITAL INPUT FUNCTIONS:</u>				
1. O/A Humidity:				
Humidity Switch	105	1.5 (E)	35	140
DI Common Costs	<u>139</u>	<u>8.4 (E)</u>	<u>193</u>	<u>332</u>
Totals	244	9.9 (E)	228	472
<u>ANALOG INPUT FUNCTIONS:</u>				
1. - Damper (Valve) Continuous Position				
Potentiometer	135	2.0 (E)	46	181
Potentiometer-Current Transducer	75	0.9 (E)	21	96
AI Common Costs	<u>210</u>	<u>9.4 (E)</u>	<u>216</u>	<u>426</u>
Totals	<u>250</u> 420	12.3 (E)	283	703
2. Outside Air Temperature:				
RTD and Transmitter	130	2.2 (E)	51	181
Instrument Shelter	350	2.0 (E)	46	396
AI Common Costs	<u>210</u>	<u>9.4 (E)</u>	<u>216</u>	<u>426</u>
Totals	690	13.6 (E)	313	1,003
3. Duct (Point) Temperature:				
RTD and Transmitter	130	2.3 (E)	51	181
AI Common Costs	<u>210</u>	<u>9.4 (E)</u>	<u>216</u>	<u>426</u>
Totals	340	11.6 (E)	267	607

## EMCS Program: LEAD MODIFIED ECONOMIZER (Continued)

	<u>Material Cost</u>	<u>Labor MH</u>	<u>Labor Costs</u>	<u>Total Costs</u>
<u>ANALOG OUTPUT FUNCTIONS:</u>				
1. Control Point Adjustment				
Fail Low, High, or Local Loop				
CPA Controller, Pneumatic	130	1.8 (P)	41	171
I/P Converter	205	1.0 (P)	23	228
Control Relay	19	1.0 (E)	23	42
EP Valve	190	1.0 (P)	23	213
Pressure Regulator	25	0.9 (P)	21	46
AO Common Costs	200	9.4 (E)	216	416
DO Common Costs	<u>139</u>	<u>8.4 (E)</u>	<u>193</u>	<u>332</u>
Total	908	18.8(E)+4.7(P)	540	1,448

"LEAD MODIFIED" ECONOMIZER Total Estimated Cost \$4,233.00

	Material	Labor	Total
Totals	\$ 2602	\$1631	\$4233

## LEAD EMCS PROGRAM COST ESTIMATES

EMCS Program: REHEAT COIL RESET

I/O Requirements

Analog Inputs - Cold deck temperature  
 Reheat coil valve position  
 Space dry bulb temperature  
 Space relative humidity

Analog Outputs - Cold deck temperature CPA

Cost Estimate:

	<u>Material Cost</u>	<u>Labor MH</u>	<u>Labor Costs</u>	<u>Total Costs</u>
<u>ANALOG INPUT FUNCTIONS:</u>				
1. Duct (Point) Temperature:				
RTD and Transmitter	130	2.2 (E)	51	181
AI Common Costs	<u>210</u>	<u>9.4 (E)</u>	<u>216</u>	<u>426</u>
Totals	340	11.6 (E)	267	607
2. Valve Continuous				
Potentiometer	135	2.0 (E)	46	181
Potentiometer-Current				
Transducer	75	0.9 (E)	21	96
AI Common Costs	<u>210</u>	<u>9.4 (E)</u>	<u>216</u>	<u>426</u>
Totals	<del>250</del> 420	12.3 (E)	283	703
3. Space Temperature:				
RTD and Transmitter	125	1.4 (E)	32	157
AI Common Costs	<u>210</u>	<u>9.4 (E)</u>	<u>216</u>	<u>426</u>
Totals	335	10.8 (E)	248	583
4. Space Relative Humidity:				
RH Sensor and Transmitter	450	1.4 (E)	32	482
AI Common Costs	<u>210</u>	<u>9.4 (E)</u>	<u>216</u>	<u>426</u>
Totals	660	10.8 (E)	248	908

ANALOG OUTPUT FUNCTIONS:

1. Control Point Adjustment, Fail Low, High, or Local Loop				
CPA Controller, Pneumatic	130	1.8 (P)	41	171
I/P Converter	205	1.0 (P)	23	228
Control Relay	19	1.0 (E)	23	42
EP Valve	190	1.0 (P)	23	213
Pressure Regulator	25	0.9 (P)	21	46
AO Common Costs	200	9.4 (E)	216	416
DO Common Costs	<u>139</u>	<u>8.4 (E)</u>	<u>193</u>	<u>332</u>
Total	908	18.8(E)+4.7(P)	540	1,448

REHEAT COIL RESET Total Estimated Cost \$4,249.00.

87079

A-15

Totals

\$2663

5-19

\$1586 \$4249

LETTERKENNY ARMY DEPOT  
ENERGY MONITORING AND CONTROL SYSTEM STUDY  
FY88, OMA, PN262  
BUILDING NO. 370

INDIVIDUAL BUILDINGS EMCS SAVINGS, COST AND PAYBACK PERIOD

- A. Total (< 3 year payback) program savings \$65,757.00
- B. Total (< 3 year payback) program costs:
- |                                      |                  |
|--------------------------------------|------------------|
| Schedule Start/Stop (9 Systems)      | \$ 1,653.00 each |
| LEAD Modified Economizer (7 Systems) | \$ 4,233.00 each |
| Reheat Coil Reset (6 Systems)        | \$ 4,249.00 each |
- C. Building FID Installation Cost  
(Include Power Conditioner plus 120 Vac) \$ 5,766.00
- D. Building No. 370 Individual Payback Period 1.1 years
- Building Payback Period = Sum of Costs/Savings  
 $D = (B + C)/A$



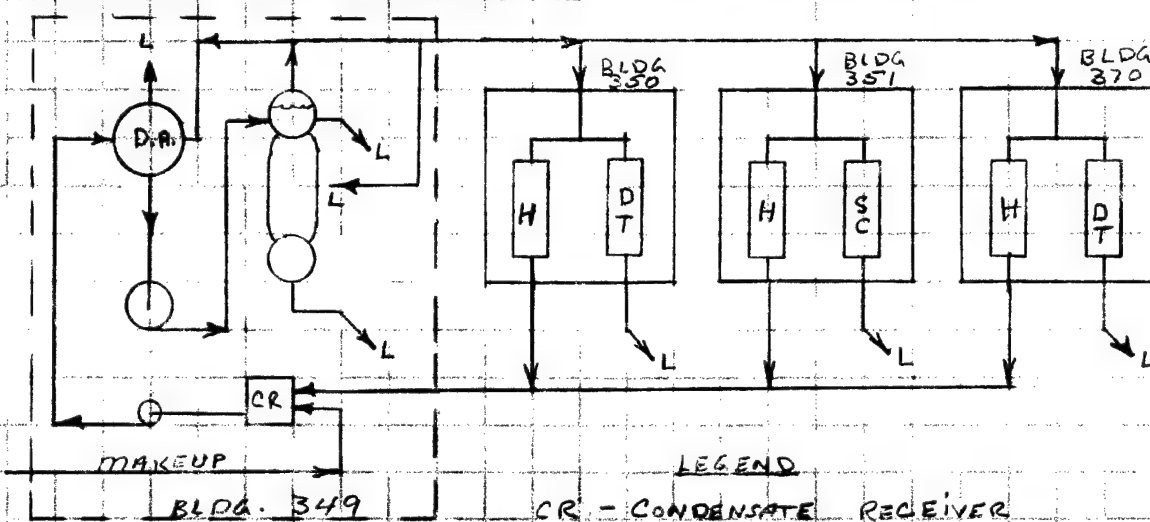


SUBJECT LETTERKENNY A.D.  
ECO #6  
 DESIGNER G.F.  
 CHECKER PA

AEP NO 290-0379-001  
 SHEET \_\_\_\_\_ OF \_\_\_\_\_  
 DATE \_\_\_\_\_  
 DATE \_\_\_\_\_

ECO#6 - REDUCE MAKEUP WATER REQUIREMENTS AT BLDG. 349

PROCESS FLOW DIAGRAM - MAIN BOILER (#349)



LEGEND

CR - CONDENSATE RECEIVER  
 DA - DEAERATING FEEDWATER HEATER  
 DT - DIP TANK HEATING  
 H - COMFORT HEATING  
 L - LOSS  
 SC - STEAM CLEANING.

STEAM LOSSES

HEAT RECOVERABLE

CONDENSATE RECOVERABLE

1. D.A. VENT	NO	NO
2. CONTINUOUS BLOWDOWN	YES	NO
3. BOTTOM BLOWDOWN	YES	NO
4. SOOT BLOWER	NO	NO
5. ATOM STEAM	NO	NO
6. BLDG 350 DIP TANKS	YES	NO
7. BLDG 351 STEAM CLEAN	NO	NO
8. BLDG 370 DIP TANKS	YES	NO

SUBJECT LETTER KENNY A.D.

AEP NO \_\_\_\_\_

ECO #6SHEET 2 OF \_\_\_\_\_

DESIGNER \_\_\_\_\_

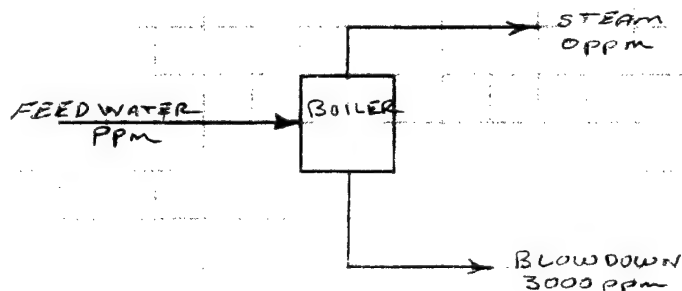
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DATE \_\_\_\_\_

HEAT RECOVERY FROM BOILER BLOWDOWN (Items 2 & 3)DETERMINE BLOW DOWN FLOW

ASSUME: 3000 ppm TDS BOILER WATER (ACMA STD)  
: 30 ppm IN FEEDWATER



$$\sum \text{WATER} = 0 = \text{FEEDWATER} - \text{STEAM FLOW} - \text{BLOW DOWN} = m_f - m_s - m_b$$

$$\sum \text{SOLIDS} = 0 = \text{FEEDWATER} \times \text{CONC.} - \text{STEAM FLOW} \times \text{CONC.} - \text{BLOW DOWN} \times \text{CONC.}$$

$$0 = m_f \times C_f - m_s C_s - m_b C_b$$

$$0 = m_f C_f - (m_f - m_b) C_s - m_b C_b$$

$$0 = m_f C_f - m_b C_b$$

$$m_b = m_f \frac{C_f}{C_b} = m_f \frac{30}{3000} = .001 m_f$$

SO BLOWDOWN  $\approx$  .1% OF STEAM FLOW

TOTAL STEAM PRODUCTION

$$\text{TOTAL STEAM PRODUCTION} = \frac{\text{TOTAL FUEL CONSUMPTION}}{\text{BOILER EFF} \times \Delta H}$$

$$= \frac{188548 \text{ MBTU/yr}}{.8 \times (1188.1 - (.8 \times 148 + .2 \times 28))}$$

$$= 221.5 \text{ MILLION LBS STEAM / yr.}$$

TOTAL BLOW DOWN

$$221.5 \times 10^6 \times .001 = 221.5 \times 10^3 \text{ LBS / yr.}$$



SUBJECT LEAD  
ECO #6  
DESIGNER \_\_\_\_\_  
CHECKER \_\_\_\_\_

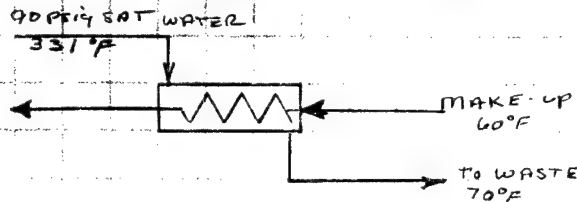
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SHEET \_\_\_\_\_ OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

### RECOVERABLE ENERGY IN BLOW DOWN

ASSUME: 10° AT COLD END APPROACH

90 PSIG BOILER PRESSURE

MAKE-UP WATER TEMP = 60°F



$$\dot{Q} = \dot{W} c_p \Delta T = \frac{221.5 \times 10^3 \text{ LBS/yr} \times (331 - 70)}{0.6 \times 10^6} = 22.3 \text{ MBTU/yr}$$

### VALUE OF RECOVERED ENERGY

$$22.3 \text{ MBTU/yr} \times \$0.61/\text{MBTU} = \$478/\text{yr}$$

$$\text{CONSTRUCTION COST} = \$9297$$

$$\text{PAYBACK} = \frac{\$9297}{\$478/\text{yr}} = 19.4 \text{ YEARS} \Rightarrow \text{NOT RECOMMENDED}$$



SUBJECT LEAD  
ECO #6  
DESIGNER \_\_\_\_\_  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET \_\_\_\_\_ OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

## HEAT RECOVERY FROM DIP TANK CONDENSATE.

### DIP TANK STEAM CONSUMPTION

DURING NON-WORK SUMMERTIME WEEKENDS THE ONLY STEAM CONSUMERS ARE THE DIP TANKS IN BUILDINGS 350 & 370. SINCE THESE ARE THE ONLY CONSUMERS AND THE CONDENSATE IS DUMPED, THE MAKEUP FLOW IS EQUAL TO THE STEAM FLOW AND THE CONDENSATE FLOW.

### 1990 AUGUST WEEKEND MAKEUP FLOW DATA

DATE	MAKEUP FLOW (GPD)
4	2891
5	2800
11	2800
12	2800
18	3200
19	3300
25	4000
26	3300
TOTAL	25100
AVERAGE (GPD)	3140
AVERAGE (#/HR)	1090

THERE ARE 11 HEATED TANKS TOTALING 19,200 gal. THE TANKS OPERATE AT APPROXIMATELY THE SAME TEMPERATURE. THE STEAM CAN BE ASSUMED TO BE CONSUMED AS A FUNCTION OF TANK CAPACITY. THE CONDENSATE TEMPERATURE IS EQUAL TO THE TANK TEMPERATURE

$$\frac{1090 \text{ \#/HR}}{19200 \text{ gal}} = 0.0568 \text{ \# STEAM/HR/gal}$$



SUBJECT HEAD  
ECO #6  
DESIGNER \_\_\_\_\_  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET \_\_\_\_\_ OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

350 N

4 TANKS @ 3000 gal ea = 12,000 gal  
2 TANKS @ 500 gal ea = 1,000 gal  
13,000 gal

TOTAL STEAM CONSUMPTION

$$13,000 \text{ gal} \times 0.0568 \text{ \#STEAM/HR/gal} = 738 \text{ LBS STM/HR.}$$

RECOVERABLE ENERGY IN CONDENSATE

ASSUME: 68°F INDOOR TEMP., 10° H/X APPROACH.

$$738 \text{ LBS STM/HR} \times (180 - 78) = 75,300 \text{ BTU/HR}$$

ANNUAL HEAT RECOVERY

$$\frac{75,300 \text{ BTU/HR}}{106 \text{ BTU/MBTU} \times 0.8} \times 6687 \text{ HR/YR} = 629 \text{ MBTU/YR} \text{ \#6 OIL}$$



SUBJECT LEAD  
ECO #6  
DESIGNER \_\_\_\_\_  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET \_\_\_\_\_ OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

350 S

$$2 \text{ TANKS @ } 1600 \text{ gal @ } = 3200 \text{ gal}$$

TOTAL STEAM CONSUMPTION

$$3200 \text{ gal} \times 0.0568 \text{ #STM/HR/gal} = 182 \text{ LBS STM/HR}$$

RECOVERABLE ENERGY IN CONDENSATE

$$182 \text{ LBS STM/HR} \times (180 - 78) = 18500 \text{ BTU/HR}$$

ANNUAL HEAT SAVED

$$\frac{18500 \text{ BTU/HR}}{10^6 \text{ BTU/MATU} \times 0.8} \times 6687 \text{ HRS/YR} = 155 \text{ MBTU/YR}$$

#6 OIL



SUBJECT LEAD  
ECO #6  
DESIGNER \_\_\_\_\_  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET \_\_\_\_\_ OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

370

3 TANKS @ 1000 gal @ = 3000 gal

TOTAL STEAM CONSUMPTION

3000 gal X 0.0568 #s/hr.gal = 170 LBS STM/HR

RECOVERABLE ENERGY IN CONDENSATE

170 LBS STM/HR X (180-72) = 18400 BTU/HR

ANNUAL ENERGY RECOVERY

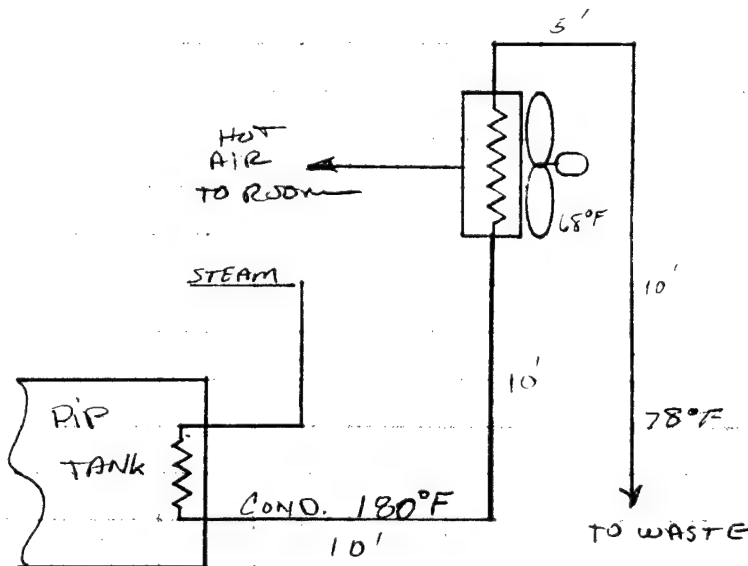
$$\frac{18400 \text{ BTU/HR}}{10^6 \text{ BTU/MWH} \times 0.8} \times 6687 \text{ HRS/YR} = 154 \frac{\text{M BTU}}{\text{YR}} \text{ #6 oil}$$



SUBJECT LEAD  
ECO #6  
 DESIGNER \_\_\_\_\_  
 CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
 SHEET \_\_\_\_\_ OF \_\_\_\_\_  
 DATE \_\_\_\_\_  
 DATE \_\_\_\_\_

## DIP TANK CONDENSATE HEAT RECOVERY



1 HYDRONIC HEATER,  
 35 ft - 1"  $\phi$  SCH 40 PIPE,  
 3 1"  $\phi$  " " " ELS.  
 NO INSULATION

ONE UNIT REQUIRED @  
 EACH GROUP OF DIP TANKS,  
 3 TOTAL.

$$\text{TOTAL ENERGY SAVED} = 629 + 155 + 154 = 938 \text{ MBTU/YR}$$

$$\text{TOTAL CONSTRUCTION COST} \$2701$$

### QRIP Calculations

$$\begin{aligned} \text{Present energy use} &= \{(738 + 182 + 170) \#/\text{hr}\} \times 6687 \text{ hr/yr} \times 1050 \frac{\text{Btu}}{\text{lb}} \\ &= \underline{7653 \text{ MBtu/yr}} \times 4.41 \#/\text{MBtu} = \underline{\underline{\$33,800/\text{yr}}} \end{aligned}$$



# LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 24

Room or Supply Air Conditions - Winter 68  
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 1  
9 AM - 5 PM 1  
5 PM - 1 AM 1

Operation Days Per Week 5

Temp. Range	Hours of Occurrence			Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
	2-9	10-17	18-1						
70	74	247	237	301	795	-4	1.08	1	0
65	69	296	217	278	791	1	1.08	1	854
60	64	269	196	236	701	6	1.08	1	4,542
55	59	249	191	209	649	11	1.08	1	7,710
50	54	221	193	202	616	16	1.08	1	10,644
45	49	218	193	206	617	21	1.08	1	13,994
40	44	237	236	239	712	26	1.08	1	19,993
35	39	289	246	286	821	31	1.08	1	27,487
30	34	304	194	258	756	36	1.08	1	29,393
25	29	184	106	152	442	41	1.08	1	19,572
20	24	124	65	90	279	46	1.08	1	13,861
15	19	75	32	57	164	51	1.08	1	9,033
10	14	54	13	26	93	56	1.08	1	5,625
5	9	18	3	9	30	61	1.08	1	1,976
0	4	9	0	2	11	66	1.08	1	784
-5	-1	3	0	1	4	71	1.08	1	307
-10	-6	1	0	0	1	76	1.08	1	82
-15	-11	0	0	0	0	81	1.08	1	0
Totals									165,858
	2798	2122	2552	7472					

Total Operation Hours While Heating  
(and corrected for working days/week) 4776 118,470

Avg outdoor temp while heating (F) 45.0

7472  
- 785  
-----  
6687 HRS OF HEATING

05/16/91

ECO Construction Cost Estimate  
Calculations

ECO Name: Condensate heat recovery - dip tank heat exchanger

ECO #: 6

1991 ECO "bare" costs (from cost estimate sheet)

Material	\$1,310
Labor	\$274

Subtotal bare costs	\$1,584
---------------------	---------

FICA Insurance (20% of Labor)	\$55
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Sales Tax (6.5% of Material)	\$85
------------------------------	------

Subtotal	\$1,724
----------	---------

Overhead (15%)	\$259
----------------	-------

Subtotal	\$1,983
----------	---------

Profit (10%)	\$198
--------------	-------

Subtotal	\$2,181
----------	---------

Bond (1%)	\$22
-----------	------

Subtotal	\$2,203
----------	---------

Contingency (10%)	\$220
-------------------	-------

Subtotal (Construction Cost Input For LCCID *)	\$2,423
--	---------

SIOH (5.5% of Construction Cost)	\$133
----------------------------------	-------

Subtotal	\$2,556
----------	---------

Design (6% of Construction Cost)	\$145
----------------------------------	-------

Total Project Cost	\$2,701
--------------------	---------

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.



05/16/91

ECO Construction Cost Estimate  
Calculations

ECO Name: Condensate heat recovery - blow down heat exchanger

ECO #: 6

1991 ECO "bare" costs (from cost estimate sheet)		
Material		\$3,340
Labor		\$1,980
	Subtotal bare costs	\$5,320
FICA Insurance (20% of Labor)		\$396
Sales Tax (6.5% of Material)		\$217
	Subtotal	\$5,933
Overhead (15%)		\$890
	Subtotal	\$6,823
Profit (10%)		\$682
	Subtotal	\$7,505
Bond (1%)		\$75
	Subtotal	\$7,580
Contingency (10%)		\$758
		+-----+
Subtotal (Construction Cost Input For LCCID *)		\$8,338
		+-----+
SIOH (5.5% of Construction Cost)		\$459
	Subtotal	\$8,797
Design (6% of Construction Cost)		\$500
		-----
Total Project Cost		\$9,297

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.



ECO # 8

Reflectors for Fluorescent fixtures in Building 370

Assumptions:

1. The Fluorescent lights in the casing repair area are on 2 shifts, 5 days per week (4160 hr/yr)
2. Two lamps and one ballast will be removed from each fixture.
3. The ballasts uses 20 % of the lamp energy which is 16 watts for 2, 40-watt lamps.

Current Energy Consumption:

$$450 \text{ Fixt.} \times 4 \frac{\text{lamps}}{\text{Fixt.}} \times 40 \frac{\text{watt}}{\text{lamp}} \times 1.2 \times \frac{1 \text{ kw}}{1000 \text{ w}} = 86.4 \text{ kw}$$

$$86.4 \text{ kw} \times 4160 \text{ hr/yr} = 359,424 \text{ kwh/yr}$$

Energy consumption with reflectors:

$$450 \text{ Fixt.} \times 2 \frac{\text{lamp}}{\text{Fixt.}} \times 40 \frac{\text{w}}{\text{lamp}} \times 1.2 \times \frac{1 \text{ kw}}{1000 \text{ w}} = 43.2 \text{ kw}$$

$$43.2 \text{ kw} \times 4160 \text{ hr/yr} = 179,712 \text{ kwh/yr}$$

Energy Savings

$$(359,424 - 179,712) \frac{\text{kwh}}{\text{yr}} = \underline{179,712 \text{ kwh/yr}}$$

$$179,712 \text{ Kwh/yr} \times 3413 \frac{\text{Btu}}{\text{kwh}} \times \frac{1 \text{ MBtu}}{10^6 \text{ Btu}} = \underline{613.4 \frac{\text{MBtu}}{\text{yr}}}$$

Energy Cost Savings:

$$179,712 \text{ Kwh/yr} \times \$0.0373/\text{kwh} = \underline{\$6703/\text{yr}}$$

Project Implementation Cost:

$$\text{Total Project Cost} = \underline{\$35,699}$$

See Cost Estimate sheets for details

Simple Payback:

$$\text{Payback} = \text{Cost} \div \text{Savings}$$

$$= \$35,699 \div \$6,703/\text{yr}$$

$$\text{Payback} = \underline{5.3 \text{ years}}$$

05/14/91

ECO Construction Cost Estimate  
Calculations

ECO Name: Reflectors For Fluorescent Fixtures In Building 370

ECO #: 8

1991 ECO "bare" costs (from cost estimate sheet)

Material	\$11,250
Labor	\$9,000

Subtotal bare costs	\$20,250
---------------------	----------

FICA Insurance (20% of Labor)	\$1,800
-------------------------------	---------

Sales Tax (6.5% of Material)	\$731
------------------------------	-------

Subtotal	\$22,781
----------	----------

Overhead (15%)	\$3,417
----------------	---------

Subtotal	\$26,198
----------	----------

Profit (10%)	\$2,620
--------------	---------

Subtotal	\$28,818
----------	----------

Bond (1%)	\$288
-----------	-------

Subtotal	\$29,106
----------	----------

Contingency (10%)	\$2,911
-------------------	---------

Subtotal (Construction Cost Input For LCCID *)	\$32,017
--	----------

SIOH (5.5% of Construction Cost)	\$1,761
----------------------------------	---------

Subtotal	\$33,778
----------	----------

Design (6% of Construction Cost)	\$1,921
----------------------------------	---------

Total Project Cost	\$35,699
--------------------	----------

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.



# CONSTRUCTION COST ESTIMATE

DATE PREPARED

May 6, 1991

SHEET 1 OF

PROJECT

ENERGY ENGINEERING ANALYSIS

LOCATION

Letterkenny Army Depot

ARCHITECT ENGINEER

REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE

- ☒ CODE A (No design completed)  
☐ CODE B (Preliminary design)  
☐ CODE C (Final design)  
☐ OTHER (Specify)

DRAWING NO.

ESTIMATOR

W. T. Todd

CHECKED BY

Reflectors

SUMMARY

QUANTITY

LABOR

MATERIAL

TOTAL COST

NO. UNITS

UNIT MEAS.

PER UNIT

TOTAL

PER UNIT

TOTAL

specular, aluminum  
reflector for 2'x4'  
Fluorescent fixture.

450

Ea

20

9,000

25

11,250

\$20,250

Source: Fluor-Tech Inc.  
P.O. Box 819  
Pismo Beach, CA 93448

Mr. Darryl Masters

Assume two hours per fixture for installation (maximum) at \$10 per hour.

Project No. 290-0379-001

Local L.D. Placed  Rec'd.  Date 5-3-91
B. Todd Conversed With Daryl Masters

Of Fluor-Tech Inc. Regarding Reflectors for LEAD

Ph: 800-423-9206 Fax: 805-773-6665

FTI does custom fabrication of reflectors for fluorescent light fixtures. For an accurate quote he needs to see pictures of the particular type of fixtures to be retrofitted. Material costs will be about \$3.15 per s.f. of reflector. Installation costs will vary greatly depending upon if the lamp connector posts have to be moved or not.

For the fixtures at LEAD Bldg. 370 FTI would cut slots in the reflectors directly above the lamps to provide some uplighting.

FTI

P.O. Box 819

Pismo Beach, CA 93448

Distribution:



SUBJECT LETTERKENNY A.D.  
ECO 9  
DESIGNER C.F.  
CHECKER \_\_\_\_\_

AEP NO 290-0379-001  
SHEET 1 OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

ECO #9 Paint Booth Fan Control : Bldg 350, Booth #61  
CURRENT ENERGY COSTS

NO. 6 OIL

ASSUME:  $68^{\circ}\text{F}$  EXHAUST AIR, 2 SHIFT OPERATION

74,233 BTU / CM / YR.

12141 CFM EXHAUST FLOW

BOILER EFFICIENCY = 0.8

HEAT LOSS FY91 Fuel Prices except for Q

$$HL = \frac{74,233 \text{ B/CM/YR} \times 12,141 \text{ CFM}}{0.8 \times 10^6} = 1127 \text{ MBTU/YR}$$

HEAT LOSS COST

$$1130 \text{ MBTU/YR} \times \$4.41/\text{MBTU} = \$4983/\text{YR}$$

ELECTRICITY

ASSUME: 2 HP MOTOR (BKA, INC. REPORT)

ENERGY CONSUMED

$$2 \text{ HP} \times .746 \text{ kW/HP} \times 16 \text{ H/D} \times 5 \text{ d/W} \times 52 \text{ W/YR} = 621.0 \text{ kWh}$$

COST

$$= 21. \frac{\text{MBTU}}{\text{YR}}$$

$$621.0 \text{ kWh} \times \$0.0373/\text{kWh} = \$230/\text{YR}$$

TOTAL COST

$$\$4983/\text{YR} + \$230/\text{YR} = \$5213/\text{YR}$$

SAVINGS

ASSUME: FAN IS OFF FOR 1/2 TIME

SUBJECT LEAD ECO #9

AEP NO \_\_\_\_\_

DESIGNER \_\_\_\_\_

SHEET 2 OF \_\_\_\_\_

CHECKER \_\_\_\_\_

DATE \_\_\_\_\_

DATE \_\_\_\_\_

SAVINGS CONT.No. 6 OILENERGY

$$\frac{1127 \text{ MBTU/yr}}{2} = \underline{\underline{564 \text{ MBTU/yr}}}$$

COST

$$564 \text{ MBTU/yr} \times \$4.41/\text{MBTU} = \underline{\underline{\$2487/\text{yr}}}$$

ELECTRICITYENERGY

$$\frac{6210 \text{ kWh/yr}}{2} = 3110 \text{ kWh/yr} = \underline{\underline{11 \text{ MBTU/yr}}}$$

COST

$$3110 \text{ kWh/yr} \times \$0.0373/\text{kWh} = \underline{\underline{\$120/\text{yr}}}$$

TOTAL SAVINGS

$$\text{COST SAVINGS} = \text{OIL SAVINGS} + \text{ELEC. SAVINGS}$$

$$= \$2487/\text{yr} + \$120/\text{yr}$$

$$= \underline{\underline{\$2607/\text{yr}}}$$

$$\text{ENERGY SAVINGS} = 564 \frac{\text{MBTU}}{\text{yr}} + 11 \frac{\text{MBTU}}{\text{yr}}$$

$$= \underline{\underline{575 \text{ MBTU/yr}}}$$

ECO #9  
Fan Controls For Open Paint Booths  
Letterkenny Army Depot  
10/14/91

Building Number: 350  
Paint Booth No.: 2527

Heating Fuel Type: #6 Fuel Oil  
Heating Fuel Cost: \$4.41 /MBtu  
Boiler Efficiency: 80%  
Electricity Cost: \$10.94 /MBtu  
Exhaust Fan Motor: 5 HP  
Exhaust Air Flow: 25,959 CFM  
Makeup Percentage: 100%  
Exhaust Air Temp.: 68 °F  
O A Heating Load: 74,233 Btu/cfm-Yr  
Operating Shifts: 2 /Day  
Operating Days: 5 /Week

Current Energy Use:

Current Heating Energy =	2409 MBtu/Yr
Heating Energy Cost =	\$10,624 /Yr
Current Electric Use =	53 MBtu/Yr
Electricity Cost =	\$580 /Yr
Current Energy Use =	2462 MBtu/Yr
Current Energy Cost =	\$11,204 /Yr

Savings if fan is turned off 50% of the time:

Heating Energy Savings =	1205 MBtu/Yr
Heating Cost Savings =	\$5,314 /Yr
Electric Energy Savings =	27 MBtu/Yr
Electric Cost Savings =	\$295 /Yr
Total Energy Savings =	1232 MBtu/Yr
Total Energy Cost Savings =	\$5,609 /Yr

ECO #9  
Fan Controls For Open Paint Booths  
Letterkenny Army Depot  
10/14/91

Building Number: 37  
Paint Booth No.: 280

Heating Fuel Type: #6 Fuel Oil  
Heating Fuel Cost: \$4.41 /MBtu  
Boiler Efficiency: 80%  
Electricity Cost: \$10.94 /MBtu  
Exhaust Fan Motor: 3 HP  
Exhaust Air Flow: 18,318 CFM  
Makeup Percentage: 100%  
Exhaust Air Temp.: 68 °F  
D A Heating Load: 74,233 Btu/cfm-Yr  
Operating Shifts: 2 /Day  
Operating Days: 5 /Week

Current Energy Use:

Current Heating Energy =	1700 MBtu/Yr
Heating Energy Cost =	\$7,497 /Yr
Current Electric Use =	32 MBtu/Yr
Electricity Cost =	\$350 /Yr
Current Energy Use =	1732 MBtu/Yr
Current Energy Cost =	\$7,847 /Yr

Savings if fan is turned off 50% of the time:

Heating Energy Savings =	850 MBtu/Yr
Heating Cost Savings =	\$3,749 /Yr
Electric Energy Savings =	16 MBtu/Yr
Electric Cost Savings =	\$175 /Yr
Total Energy Savings =	866 MBtu/Yr
Total Energy Cost Savings =	\$3,924 /Yr

ECO #9

Fan Controls For Open Paint Booths  
Letterkenny Army Depot  
10/14/91

Building Number: 37  
Paint Booth No.: 468

Heating Fuel Type: #6 Fuel Oil  
Heating Fuel Cost: \$4.41 /MBtu  
Boiler Efficiency: 80%  
Electricity Cost: \$10.94 /MBtu  
Exhaust Fan Motor: 2 HP  
Exhaust Air Flow: 11,152 CFM  
Makeup Percentage: 100%  
Exhaust Air Temp.: 68 °F  
O A Heating Load: 74,233 Btu/cfm-Yr  
Operating Shifts: 2 /Day  
Operating Days: 5 /Week

Current Energy Use:

Current Heating Energy =	1035 MBtu/Yr
Heating Energy Cost =	\$4,564 /Yr
Current Electric Use =	21 MBtu/Yr
Electricity Cost =	\$230 /Yr
Current Energy Use =	1056 MBtu/Yr
Current Energy Cost =	\$4,794 /Yr

Savings if fan is turned off 50% of the time:

Heating Energy Savings =	518 MBtu/Yr
Heating Cost Savings =	\$2,284 /Yr
Electric Energy Savings =	11 MBtu/Yr
Electric Cost Savings =	\$120 /Yr
Total Energy Savings =	529 MBtu/Yr
Total Energy Cost Savings =	\$2,404 /Yr

ECO #9

Fan Controls For Open Paint Booths  
Letterkenny Army Depot  
10/14/91

Building Number: 37  
Paint Booth No.: 470

Heating Fuel Type: #6 Fuel Oil  
Heating Fuel Cost: \$4.41 /MBtu  
Boiler Efficiency: 80%  
Electricity Cost: \$10.94 /MBtu  
Exhaust Fan Motor: 3 HP  
Exhaust Air Flow: 12,069 CFM  
Makeup Percentage: 100%  
Exhaust Air Temp.: 68 °F  
O A Heating Load: 74,233 Btu/cfm-Yr  
Operating Shifts: 2 /Day  
Operating Days: 5 /Week

Current Energy Use:

Current Heating Energy =	1120 MBtu/Yr
Heating Energy Cost =	\$4,939 /Yr
Current Electric Use =	32 MBtu/Yr
Electricity Cost =	\$350 /Yr
Current Energy Use =	1152 MBtu/Yr
Current Energy Cost =	\$5,289 /Yr

Savings if fan is turned off 50% of the time:

Heating Energy Savings =	560 MBtu/Yr
Heating Cost Savings =	\$2,470 /Yr
Electric Energy Savings =	16 MBtu/Yr
Electric Cost Savings =	\$175 /Yr
Total Energy Savings =	576 MBtu/Yr
Total Energy Cost Savings =	\$2,645 /Yr



ECO #9  
Fan Controls For Open Paint Booths  
Letterkenny Army Depot  
10/14/91

Building Number: 370  
Paint Booth No.: 200

Heating Fuel Type: #6 Fuel Oil  
Heating Fuel Cost: \$4.41 /MBtu  
Boiler Efficiency: 80%  
Electricity Cost: \$10.94 /MBtu  
Exhaust Fan Motor: 5 HP  
Exhaust Air Flow: 17,100 CFM  
Makeup Percentage: 100%  
Exhaust Air Temp.: 68 °F  
O A Heating Load: 35,618 Btu/cfm-Yr  
Operating Shifts: 1 /Day  
Operating Days: 5 /Week

Current Energy Use:

Current Heating Energy =	761 MBtu/Yr
Heating Energy Cost =	\$3,356 /Yr
Current Electric Use =	26 MBtu/Yr
Electricity Cost =	\$284 /Yr
Current Energy Use =	787 MBtu/Yr
Current Energy Cost =	\$3,640 /Yr

Savings if fan is turned off 50% of the time:

Heating Energy Savings =	381 MBtu/Yr
Heating Cost Savings =	\$1,680 /Yr
Electric Energy Savings =	13 MBtu/Yr
Electric Cost Savings =	\$142 /Yr
Total Energy Savings =	394 MBtu/Yr
Total Energy Cost Savings =	\$1,822 /Yr

ECO #9

Fan Controls For Open Paint Booths  
Letterkenny Army Depot  
10/14/91

Building Number: 370  
Paint Booth No.: 412

Heating Fuel Type: #6 Fuel Oil  
Heating Fuel Cost: \$4.41 /MBtu  
Boiler Efficiency: 80%  
Electricity Cost: \$10.94 /MBtu  
Exhaust Fan Motor: 1.5 HP  
Exhaust Air Flow: 6,147 CFM  
Makeup Percentage: 100%  
Exhaust Air Temp.: 68 °F  
O A Heating Load: 35,618 Btu/cfm-Yr  
Operating Shifts: 1 /Day  
Operating Days: 5 /Week

Current Energy Use:

Current Heating Energy =	274 MBtu/Yr
Heating Energy Cost =	\$1,208 /Yr
Current Electric Use =	8 MBtu/Yr
Electricity Cost =	\$88 /Yr
Current Energy Use =	282 MBtu/Yr
Current Energy Cost =	\$1,296 /Yr

Savings if fan is turned off 50% of the time:

Heating Energy Savings =	137 MBtu/Yr
Heating Cost Savings =	\$604 /Yr
Electric Energy Savings =	4 MBtu/Yr
Electric Cost Savings =	\$44 /Yr
Total Energy Savings =	141 MBtu/Yr
Total Energy Cost Savings =	\$648 /Yr

ECO #9

Fan Controls For Open Paint Booths

Letterkenny Army Depot

10/14/91

Building Number: 370  
Paint Booth No.: 3877

Heating Fuel Type: #6 Fuel Oil  
Heating Fuel Cost: \$4.41 /MBtu  
Boiler Efficiency: 80%  
Electricity Cost: \$10.94 /MBtu  
Exhaust Fan Motor: 2 HP  
Exhaust Air Flow: 11,956 CFM  
Makeup Percentage: 100%  
Exhaust Air Temp.: 68 °F  
O A Heating Load: 35,618 Btu/cfm-Yr  
Operating Shifts: 1 /Day  
Operating Days: 5 /Week

Current Energy Use:

Current Heating Energy =	532 MBtu/Yr
Heating Energy Cost =	\$2,346 /Yr
Current Electric Use =	11 MBtu/Yr
Electricity Cost =	\$120 /Yr
Current Energy Use =	543 MBtu/Yr
Current Energy Cost =	\$2,466 /Yr

Savings if fan is turned off 50% of the time:

Heating Energy Savings =	266 MBtu/Yr
Heating Cost Savings =	\$1,173 /Yr
Electric Energy Savings =	6 MBtu/Yr
Electric Cost Savings =	\$66 /Yr
Total Energy Savings =	272 MBtu/Yr
Total Energy Cost Savings =	\$1,239 /Yr

ECO #9  
Fan Controls For Open Paint Booths  
Letterkenny Army Depot  
10/14/91

Building Number: 370  
Paint Booth No.: 4298

Heating Fuel Type: #6 Fuel Oil  
Heating Fuel Cost: \$4.41 /MBtu  
Boiler Efficiency: 80%  
Electricity Cost: \$10.94 /MBtu  
Exhaust Fan Motor: 7.5 HP  
Exhaust Air Flow: 18,592 CFM  
Makeup Percentage: 100%  
Exhaust Air Temp.: 68 °F  
O A Heating Load: 35,618 Btu/cfm-Yr  
Operating Shifts: 1 /Day  
Operating Days: 5 /Week

Current Energy Use:

Current Heating Energy =	828 MBtu/Yr
Heating Energy Cost =	\$3,651 /Yr
Current Electric Use =	40 MBtu/Yr
Electricity Cost =	\$438 /Yr
Current Energy Use =	868 MBtu/Yr
Current Energy Cost =	\$4,089 /Yr

Savings if fan is turned off 50% of the time:

Heating Energy Savings =	414 MBtu/Yr
Heating Cost Savings =	\$1,826 /Yr
Electric Energy Savings =	20 MBtu/Yr
Electric Cost Savings =	\$219 /Yr
Total Energy Savings =	434 MBtu/Yr
Total Energy Cost Savings =	\$2,045 /Yr

ECO #9 Project Summary  
 Fan Controls For Open Paint Booths  
 Letterkenny Army Depot  
 10/21/91

4.41    4.41    10.94

Building Number	Booth Number	Energy Savings (MBtu/Yr)				Energy Cost Savings (\$/Yr)				CURRENT COSTS		
		#5 Oil	#6 Oil	Elect	Total	#5 Oil	#6 Oil	Elect	Total	FUEL OIL	ELEC.	TOTAL
350	61		564	11	575	\$0	\$2,487	\$120	\$2,608	\$4,983	\$230	\$5,213
350	2527		1205	27	1232	\$0	\$5,314	\$295	\$5,609	\$10,624	\$580	\$11,204
37	280	850		16	866	\$3,749	\$0	\$175	\$3,924	\$7,497	\$350	\$7,847
37	468	518		11	529	\$2,284	\$0	\$120	\$2,405	\$4,564	\$230	\$4,794
37	470	560		16	576	\$2,470	\$0	\$175	\$2,645	\$4,939	\$350	\$5,289
370	200		381	13	394	\$0	\$1,680	\$142	\$1,822	\$3,356	\$284	\$3,640
370	412		137	4	141	\$0	\$604	\$44	\$648	\$1,208	\$88	\$1,296
370	3877		266	6	272	\$0	\$1,173	\$66	\$1,239	\$2,346	\$120	\$2,466
370	4298		414	20	434	\$0	\$1,826	\$219	\$2,045	\$3,651	\$438	\$4,089
Total Project		1928	2967	124	5019	\$8,502	\$13,084	\$1,357	\$22,944	\$43,168	\$2,670	\$45,838

*Handwritten:*  
 \$ 21,600

## LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 8

Room or Supply Air Conditions - Winter 68  
 Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 0.25  
 9 AM - 5 PM 0.75  
 5 PM - 1 AM 0

Operation Days Per Week 5

Temp. Range	Hours of Occurrence			Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
	2-9	10-17	18-1						
70	74	247	237	301	240	-4	1.08	1	0
65	69	296	217	278	237	1	1.08	1	256
60	64	269	196	236	214	6	1.08	1	1,388
55	59	249	191	209	206	11	1.08	1	2,441
50	54	221	193	202	200	16	1.08	1	3,456
45	49	218	193	206	199	21	1.08	1	4,519
40	44	237	236	239	236	26	1.08	1	6,634
35	39	289	246	286	257	31	1.08	1	8,596
30	34	304	194	258	222	36	1.08	1	8,612
25	29	184	106	152	126	41	1.08	1	5,557
20	24	124	65	90	80	46	1.08	1	3,962
15	19	75	32	57	43	51	1.08	1	2,355
10	14	54	13	26	23	56	1.08	1	1,406
5	9	18	3	9	7	61	1.08	1	445
0	4	9	0	2	2	66	1.08	1	160
-5	-1	3	0	1	1	71	1.08	1	58
-10	-6	1	0	0	0	76	1.08	1	21
-15	-11	0	0	0	0	81	1.08	1	0
-----									
Totals	2798	2122	2552	2291					49,865

Total Operation Hours While Heating  
 (and corrected for working days/week) 1465 35,618

Avg outdoor temp while heating (F) 45.0

## LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 16

Room or Supply Air Conditions - Winter 68  
 Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 0.375  
 9 AM - 5 PM 1  
 5 PM - 1 AM 0.625

Operation Days Per Week 5

Temp. Range	Hours of Occurrence			Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
	2-9	10-17	18-1						
70	74	247	237	301	518	-4	1.08	1	0
65	69	296	217	278	502	1	1.08	1	542
60	64	269	196	236	444	6	1.08	1	2,880
55	59	249	191	209	415	11	1.08	1	4,930
50	54	221	193	202	402	16	1.08	1	6,949
45	49	218	193	206	404	21	1.08	1	9,151
40	44	237	236	239	474	26	1.08	1	13,317
35	39	289	246	286	533	31	1.08	1	17,849
30	34	304	194	258	469	36	1.08	1	18,244
25	29	184	106	152	270	41	1.08	1	11,956
20	24	124	65	90	168	46	1.08	1	8,334
15	19	75	32	57	96	51	1.08	1	5,274
10	14	54	13	26	50	56	1.08	1	2,994
5	9	18	3	9	15	61	1.08	1	1,013
0	4	9	0	2	5	66	1.08	1	330
-5	-1	3	0	1	2	71	1.08	1	134
-10	-6	1	0	0	0	76	1.08	1	31
-15	-11	0	0	0	0	81	1.08	1	0
-----									=====
Totals	2798	2122	2552	4766					103,927

Total Operation Hours While Heating  
 (and corrected for working days/week) 3035 74,233

Avg outdoor temp while heating (F) 45.0

09/25/91

ECO Construction Cost Estimate  
Calculations

ECO Name: Walk-in Spray Booth Fan Control

ECO #: 9

1991 ECO "bare" costs (from cost estimate sheet)

Material	\$1,179
Labor	\$1,683

Subtotal bare costs	\$2,862
---------------------	---------

FICA Insurance (20% of Labor)	\$337
-------------------------------	-------

Sales Tax (6.5% of Material)	\$77
------------------------------	------

Subtotal	\$3,276
----------	---------

Overhead (15%)	\$491
----------------	-------

Subtotal	\$3,767
----------	---------

Profit (10%)	\$377
--------------	-------

Subtotal	\$4,144
----------	---------

Bond (1%)	\$41
-----------	------

Subtotal	\$4,185
----------	---------

Contingency (10%)	\$419
-------------------	-------

Subtotal (Construction Cost Input For LCCID *)	\$4,604
--	---------

SIOH (5.5% of Construction Cost)	\$253
----------------------------------	-------

Subtotal	\$4,857
----------	---------

Design (6% of Construction Cost)	\$276
----------------------------------	-------

Total Project Cost	\$5,133
--------------------	---------

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.



## CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET OF

PROJECT

ENERGY ENGINEERING ANALYSIS

LOCATION

Letterkenny Army Depot

ARCHITECT ENGINEER

REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE

- ☐ CODE A (No design completed)  
☐ CODE B (Preliminary design)  
☐ CODE C (Final design)  
☐ OTHER (Specify) \_\_\_\_\_

DRAWING NO.

ESTIMATOR

G.F.

CHECKED BY

WALK-IN SPRAY BOOTH  
FAN CONTROL SUMMARY

QUANTITY

LABOR

MATERIAL

TOTAL  
COSTNO.  
UNITSUNIT  
MEAS.PER  
UNIT

TOTAL

PER  
UNIT

TOTAL

OCCUPANCY SENSOR

1

EA

25

25

80

80

105

CONDUIT 1/2" Ø

50

LF

2.97

149

.96

48

197

WIRE 2-14

0.5

CLF

2478

13

6.22

3

16

Subtotal For 1 Booth

187

131

318

x No. of Booths

x 9

x 9

Total Bare Costs

\$1,683

\$1,179

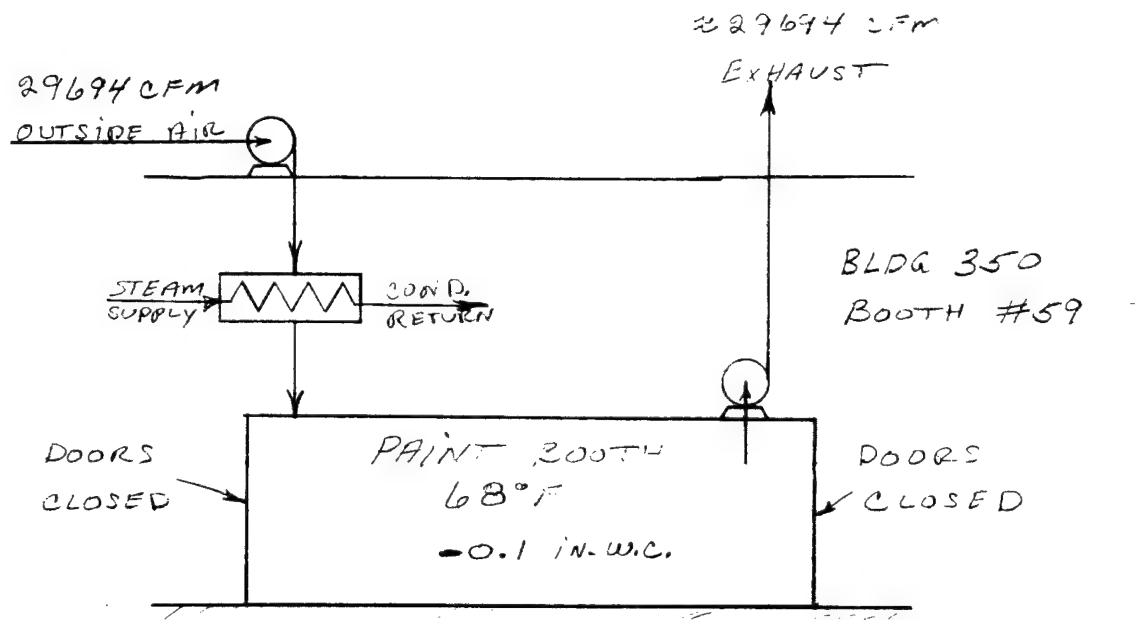
\$2,862



SUBJECT LEAD ECO#10  
DESIGNER G. Fallon  
CHECKER P. Hutchins

AEP NO 290-0379-001  
SHEET 1 OF 1  
DATE             
DATE           

## ECO #10 PAINT BOOTH AIR FLOW CONTROL



### CALCULATE CURRENT HEAT LOSS

ASSUME: 68°F EXHAUST TEMP

29,694 CFM LEAD, PAINT BOOTH STUDY, EKA, (1977, 1994)  
BOTH FANS CAN BE SHUT DOWN FOR 50%  
OF THE TIME.

24H/d, 5d/wk OPERATION

118,470 BTU/CFM/YR (HEAT LOSS CALC, ENCLOSED)

0.8 BOILER EFFICIENCY.

$$\text{Consumption} = \frac{118470 \text{ BTU/CFM} \cdot \text{YR} \times 29694 \text{ CFM}}{0.8 \times 10^6 \text{ BTU/MBTU}} = 4,400 \text{ MBTU/YR}$$

### SAVINGS \$6 oil

$$\text{ENERGY} = 4,400 \text{ MBTU/YR} \times 0.5 = \underline{\underline{2200 \text{ MBTU/YR}}}$$

\$6 oil



SUBJECT LEAD ECO #10 AEP NO \_\_\_\_\_  
DESIGNER G.F. SHEET 2 OF \_\_\_\_\_  
CHECKER \_\_\_\_\_ DATE \_\_\_\_\_  
DATE \_\_\_\_\_

ECO 10 (CONT.)

CALCULATE CURRENT ELECTRICAL CONSUMPTION

ASSUME: TOTAL DP = 5.0 IN W.C. (2.5" IN & 2.5" OUT)

$$\text{FAN \& MOTOR EFF} = 0.6 \quad \frac{2545}{6356} = 0.4$$

$$\text{FAN ENERGY} = \frac{.4 \times \text{FLOW} \times \text{HEAD}}{0.6} = \frac{.4 \times 29694 \text{ CFM} \times 5}{0.6} = 99081 \frac{\text{BTU}}{\text{Hr}}$$

$$\text{ANNUAL ENERGY} = \frac{99081 \frac{\text{BTU}}{\text{Hr}} \times 24 \text{ H/d} \times 52 \text{ Wk/YR}}{10^6 \frac{\text{BTU}}{\text{MBTU}}} = \boxed{618 \frac{\text{MBTU}}{\text{YR}}}$$

SAVINGS

ENERGY ELEC

$$618 \text{ MBTU/YR} \times 0.5 = \boxed{309 \text{ MBTU/YR ELEC}}$$

COST ELEC

$$309 \text{ MBTU/YR} \times \$10.94/\text{MBTU} = \boxed{\$3382/\text{YR ELEC.}}$$

TOTAL SAVINGS

From pg 1: #601L - 2200 MBTU/YR  
ELEC - 309 MBTU/YR

NOTE: THE ABOVE TECHNIQUE WAS APPLIED TO LARGE PAINT SPRAY BOOTHS IN BLDGS 350 & 320 USING SPREAD SHEET SOFTWARE TO GENERATE A PAYBACK ON EACH BOOTH. THE RESULTS ARE SHOWN ON THE SUMMARY SHEET.



SUBJECT LETTER KENNY A-D.

AEP NO \_\_\_\_\_

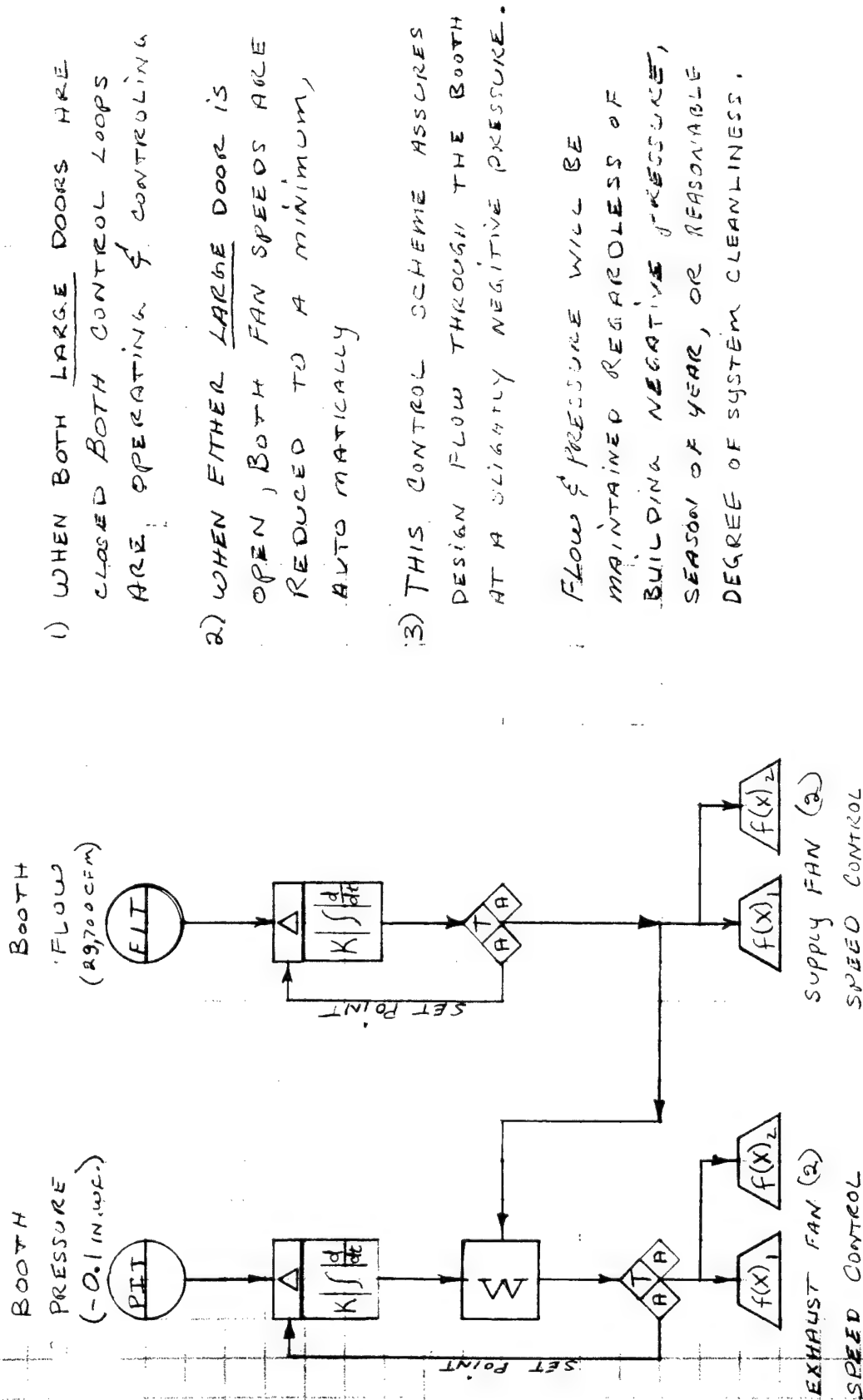
DESIGNER \_\_\_\_\_

SHEET 3 OF \_\_\_\_\_

CHECKER \_\_\_\_\_

DATE \_\_\_\_\_

DATE \_\_\_\_\_



LETTERKENNY ARMY DEPOT  
LARGE PAINT BOOTH FAN CONTROL  
SUMMARY

+-----+  
: R E C O M M E N D E D :  
+-----+

BUILDING NUMBER	BOOTH NUMBER	AIR FLOW (CFM)	OPERATION		ELEC SAVED (MBTU)	COST SAVED (\$/YR)	CONST. COST (\$)	PAYBACK (YRS)
			HOURS PER WEEK	#6 FUEL SAVED (MBTU)				
350	59	29694	120	2199	309.1	\$13,078	\$23,713	1.8
350	60	29694	120	2199	309.1	\$13,078	\$23,713	1.8
SUBTOTAL		59388	120	4397	618	\$26,156	\$47,426	1.8

BUILDING NUMBER	BOOTH NUMBER	AIR FLOW (CFM)	OPERATION		ELEC SAVED (MBTU)	COST SAVED (\$/YR)	CONST. COST (\$)	PAYBACK (YRS)
			HOURS PER WEEK	#2 FUEL SAVED (MBTU)				
320	3880	58876	40	1311	204.3	\$8,762	\$23,713	2.7
320	4378	29172	40	649	101.2	\$4,342	\$23,713	5.5
320	4379	27805	40	619	96.5	\$4,138	\$23,713	5.7
320	4380	27805	40	619	96.5	\$4,138	\$23,713	5.7
320	4381	27805	40	619	96.5	\$4,138	\$23,713	5.7
320	4382	27805	40	619	96.5	\$4,138	\$23,713	5.7
320	4383	27805	40	619	96.5	\$4,138	\$23,713	5.7
320	4384	27805	40	619	96.5	\$4,138	\$23,713	5.7
SUBTOTAL		254878	40	5674	884	\$37,932	\$189,704	5.0

+-----+			+-----+					
: GRAND TOTAL			#6 FUEL	4397	1503	\$64,088	\$237,130	3.7
:			#2 FEUL	5674				:
+-----+			+-----+					

+-----+  
: N O T R E C O M M E N D E D :  
+-----+

BUILDING NUMBER	BOOTH NUMBER	AIR FLOW (CFM)	OPERATION		ELEC SAVED (MBTU)	COST SAVED (\$/YR)	CONST. COST (\$)	PAYBACK (YRS)
			HOURS PER WEEK	#2 FUEL SAVED (MBTU)				
320	3930	2000	40	36	6.9	\$253	\$23,713	93.6
320	3931	2000	40	36	6.9	\$253	\$23,713	93.6



SUBJECT ECO # 10  
DESIGNER P. Hutchins  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET \_\_\_\_\_ OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

## QRIP Calculations Using FY92 Fuel Oil Prices

Current energy use:

$$\begin{aligned}\text{\#6 Fuel Oil} &= \frac{HCF \times CFM \times 4.41 \text{ \$/MBtu}}{0.8 \times 10^6} \\ &= \frac{118,470 \text{ Btu} \times 59,388 \text{ CFM} \times 4.41}{\text{CFM} \times 10^6} = \underline{\underline{\$ 38,800}}\end{aligned}$$

$$\text{\#2 Fuel Oil} = \frac{118,470 \times 254,878 \times 4.98}{0.8 \times 10^6} = \underline{\underline{\$ 188,000}}$$

$$\begin{aligned}\text{Electricity} &= \frac{CFM \cdot \Delta P \cdot 2.545 \text{ Btu/hp-hr} \times \text{hrs/yr.}}{6356 \times \eta_F} \\ &= \frac{254,878 \times 5 \times 2545 \times 24 \text{ h/d} \times 52 \text{ w/yr}}{6356 \times 0.6} \\ &= 5307 \text{ MBtu}\end{aligned}$$

$$\text{Cost} = 5307 \times 10.94 \text{ \$/MBtu} = \underline{\underline{\$ 35,000}}$$

$$\text{TOTAL COST} = \underline{\underline{\$ 261,800}}$$

# LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 24

Room or Supply Air Conditions - Winter 68  
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 1  
9 AM - 5 PM 1  
5 PM - 1 AM 1

Operation Days Per Week 5

Temp. Range		Hours of Occurrence			Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
		2-9	10-17	18-1						
70	74	247	237	301	785	-4	1.08	1	0	0
65	69	296	217	278	791	1	1.08	1	1	854
60	64	269	196	236	701	6	1.08	1	6	4,542
55	59	249	191	209	649	11	1.08	1	12	7,710
50	54	221	193	202	616	16	1.08	1	17	10,644
45	49	218	193	206	617	21	1.08	1	23	13,994
40	44	237	236	239	712	26	1.08	1	28	19,993
35	39	289	246	286	821	31	1.08	1	33	27,487
30	34	304	194	258	756	36	1.08	1	39	29,393
25	29	184	106	152	442	41	1.08	1	44	19,572
20	24	124	65	90	279	46	1.08	1	50	13,861
15	19	75	32	57	164	51	1.08	1	55	9,033
10	14	54	13	26	93	56	1.08	1	60	5,625
5	9	18	3	9	30	61	1.08	1	66	1,976
0	4	9	0	2	11	66	1.08	1	71	784
-5	-1	3	0	1	4	71	1.08	1	77	307
-10	-6	1	0	0	1	76	1.08	1	82	82
-15	-11	0	0	0	0	81	1.08	1	87	0

Totals 2798 2122 2552 7472 165,858

Total Operation Hours While Heating  
(and corrected for working days/week)

4776

118,470

Avg outdoor temp while heating (F)

45.0

# LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 8

Room or Supply Air Conditions - Winter 68  
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 0.25  
9 AM - 5 PM 0.75  
5 PM - 1 AM 0

Operation Days Per Week 5

Temp. Range	Hours of Occurrence			Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
	2-9	10-17	18-1						
70	74	247	237	301	240	-4	1.08	1	0
65	69	296	217	278	237	1	1.08	1	256
60	64	269	196	236	214	6	1.08	1	1,388
55	59	249	191	209	206	11	1.08	1	2,441
50	54	221	193	202	200	16	1.08	1	3,456
45	49	218	193	206	199	21	1.08	1	4,519
40	44	237	236	239	236	26	1.08	1	6,634
35	39	289	246	286	257	31	1.08	1	8,596
30	34	304	194	258	222	36	1.08	1	8,612
25	29	184	106	152	126	41	1.08	1	5,557
20	24	124	65	90	80	46	1.08	1	3,962
15	19	75	32	57	43	51	1.08	1	2,355
10	14	54	13	26	23	56	1.08	1	1,406
5	9	18	3	9	7	61	1.08	1	445
0	4	9	0	2	2	66	1.08	1	160
-5	-1	3	0	1	1	71	1.08	1	58
-10	-6	1	0	0	0	76	1.08	1	21
-15	-11	0	0	0	0	81	1.08	1	0
Totals									49,865

Total Operation Hours While Heating  
(and corrected for working days/week) 1465

35,618

Avg outdoor temp while heating (F) 45.0



10/01/91

ECO Construction Cost Estimate  
Calculations

ECO Name: Paint Booth Air Flow Control

ECO #: 10

1991 ECO "bare" costs (from cost estimate sheet)

Material	\$113,210
Labor	\$25,630

Subtotal bare costs	\$138,840
FICA Insurance (20% of Labor)	\$5,126
Sales Tax (6.5% of Material)	\$7,359

Subtotal	\$151,325
Overhead (15%)	\$22,699

Subtotal	\$174,024
Profit (10%)	\$17,402

Subtotal	\$191,426
Bond (1%)	\$1,914

Subtotal	\$193,340
Contingency (10%)	\$19,334

Subtotal (Construction Cost Input For LCCID *)	\$212,674
--	-----------

SIOH (5.5% of Construction Cost)	\$11,697
----------------------------------	----------

Subtotal	\$224,371
Design (6% of Construction Cost)	\$12,760

Total Project Cost	\$237,131
--------------------	-----------

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.



NOTE: VENDOR ADVISES EQUIPMENT BELOW  
CAN ACCOMMODATE 2 BOOTHS. THEREFOR  
EACH BOOTH COSTS  $\approx$  \$1,000.00

### Cameron & Barkley Company

Flexible Manufacturing Systems  
10200 Alton Box Rd., Box 26879  
Jacksonville, FL 32218  
(904) 757-0211

## CamBar

GEORGE FALLON  
REYNOLD & SMITH & HILLS  
4651 SALISBURY RD.  
JACKSONVILLE FL, 32256

### MODICON COMPACT 984 CONFIGURATION

		<u>CONTROLLER HARDWARE</u>		
1	1	PC-0984-120	400.00	400.00
		1.5K Compact-984 CPU		
		<u>MISC ITEMS</u>		
2	1	AS-MEEP-000	<del>200.00</del>	<del>200.00</del>
		EEPROM Memory Card		
		<u>I/O MODULES</u>		
3	1	AS-BADU-205	375.00	375.00
		+/-10V, +/-20mA analog input module		
4	1	AS-BDAP-209	160.00	160.00
		115 VAC Output Module		
5	1	AS-BDAU-202	435.00	435.00
		4-20 mA Analog Input		
6	1	AS-BDEP-209	115.00	115.00
		115 VAC Input Module		
7	1	AS-P120-000	200.00	200.00
		120 VAC - 24 VDC Power Converter		
		<u>HOUSINGS</u>		
8	1	AS-HDTA-200	165.00	165.00
		primary subrack		
9	1	AS-HDTA-201	165.00	165.00
		secondary subrack - 5 module		
		<u>CABLES</u>		
10	1	AS-WBXT-201	70.00	70.00
		Bus Extension Cable		

TOTAL AMOUNT:

~~2285.00~~

NOTE: ALL MODICON EQUIPMENT COMES WITH A THREE YEAR WARRANTY. ~~2285.00~~  
PLEASE REFER TO THIS QUOTATION NUMBER. #99-910515-P004

MARK J. WALKER  
SYSTEMS SPECIALIST



SUBJECT LETTER KENNY A D.  
ECO # 11  
DESIGNER G F  
CHECKER \_\_\_\_\_

AEP NO 290-0379-001  
SHEET 1 OF 5  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

ECO # 11

BLAST BOOTH FAN SHUT-OFF (BOOTH 49)

REF 1. LEAD, EEAP, RSH, 1981, VOL 2, PROJ-H, CALC. pg V-6  
CURRENT ENERGY CONSUMPTION

ELECTRICITY

ASSUME: FLOW = 44,000 CFM (REF. 1)

AP DUCT WORK & PAGES = 5 IN. W.C.

$\eta$  FAN & MOTOR = .6

$$\text{FAN HP} = \frac{\text{ACFM} \times \text{C.P.}}{6356 \times \eta} = \frac{44000 \times 5.0}{6356 \times .6} = 58 \text{ HP}$$

$$\text{KW} = .746 \times \text{HP} = 43 \text{ KW}$$

ENERGY CONSUMED

ASSUME: 3 SHIFT/day, 5d/wk

$$43 \text{ KW} \times 24 \text{ HR/d} \times 5 \text{ d/wk} \times 52 \text{ wk/yr} = 268,000 \text{ kWhr./yr}$$
$$\underline{916 \text{ MBTU/yr}}$$

COST OF ENERGY

$$916 \text{ MBTU/yr} \times \$10.94/\text{MBTU} = \$10,000/\text{yr.}$$

SAVINGS

ASSUME: BLASTING OCCURS FOR ONLY 1/2 TIME

ENERGY

$$916 \text{ MBTU/yr} \times .5 = \underline{458 \text{ MBTU/yr (elec.)}}$$

COSTS

$$458 \text{ MBTU/yr} \times \$10.94/\text{MBTU} = \$5010/\text{yr}$$



SUBJECT LEAD ECO #11  
DESIGNER \_\_\_\_\_  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 2 OF 5  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

ECO - 11 (CONT)

BLAST BOOTH FAN SHUT-OFF (BOOTH 50)

REF 2: LEAD, EEAP, RSH, 193', VOL 2, PROJ-H, CALC. pg VI-1

CURRENT ENERGY CONSUMPTION

ASSUME: FLOW = 56,000 CFM (REF 2)

$\Delta P$  DUCT & BAGS = 5 IN. W.C.

$\eta$  FAN & MOTOR = 0.6

$$\text{FAN HP} = \frac{\text{ACFM} \times \text{S.P.}}{6356 \times \eta} = \frac{56,000 \times 5}{6356 \times 0.6} = 73.4 \text{ HP}$$

$$\text{KW} = .746 \text{ kW/HP} \times \text{HP} = .746 \times 73.4 = 54.8 \text{ kW}$$

ENERGY CONSUMED

ASSUME 3 SHIFT / day, 5d/wk, 52wk/yr

$$54.8 \text{ kW} \times 24 \text{ H/d} \times 5 \text{ d/wk} \times 52 \text{ wk/yr} = 342,000 \text{ kWh/yr.}$$

$$342,000 \text{ kWh/yr} \times \frac{3413 \text{ Btu/kWh}}{10^6 \text{ Btu/MBtu}} = 1170 \text{ MBtu/yr}$$

$$1170 \times 10.94 = \$12,800/\text{yr}$$

SAVINGS

ASSUME BLASTING OCCURS FOR  $\frac{1}{2}$  TIME

ENERGY

$$1170 \text{ MBtu/yr} \times 0.5 = \underline{583 \text{ MBtu/yr (elec.)}}$$

COST

$$583 \text{ MBtu/yr} \times \$10.94/\text{MBtu} = \$6380/\text{yr.}$$

SUBJECT LEAD ECO #11

AEP NO. \_\_\_\_\_

DESIGNER \_\_\_\_\_

SHEET 3 OF 5

CHECKER \_\_\_\_\_

DATE \_\_\_\_\_

DATE \_\_\_\_\_

ECO -11 CONT

BLAST BOOTH FAN SHUT-OFF (BOOTH 2544)

REF 3 : LEAD, FEAP, RSH, 1981, VOL. 2, PROJ- H, CALC. pg VII-1

CURRENT ENERGY CONSUMPTION

ASSUME: FLOW = 44,000 CFM (REF 3)

AP DUCT FRAGE = 5 IN. W.G.

 $\eta$  FAN & MOTOR = 0.6VALUES ARE SAME AS BOOTH 49 (pg. 11-1) SO  
SAVINGS WILL BE THE SAME.Energy Savings = 458 kWh/yr (elec.)

SUBJECT LEAD ECO #11

AEP NO \_\_\_\_\_

DESIGNER \_\_\_\_\_

SHEET 4 OF 5

CHECKER \_\_\_\_\_

DATE \_\_\_\_\_

DATE \_\_\_\_\_

ECO. (CONT.)

BLAST BOOTH FAN SHUT OFF BLDG 37

REF 4: LEAD, EEHP, RSH, 1981, VOL. 2, PROJ H, CALC. pg X-1

FAN MOTOR HP = 20 (REF 4)

CURRENT ENERGY CONSUMED

ASSUME: 2 SHIFT OPERATION

$$20 \text{ HP} \times .746 \frac{\text{W}}{\text{HP}} \times 16 \text{ H/d} \times 50 \text{ d/w} \times 52 \text{ w/yr} = 62100 \text{ kWh}$$

$$62100 \text{ kWh/yr} \times \frac{3413 \text{ BTU/kWh}}{106 \text{ BTU/MBTU}} = 212 \text{ MBTU/yr}$$

$$212 \times 10.94 = \underline{\$2319}$$

SAVINGSASSUME: BLASTING OCCURS  $\frac{1}{2}$  TIME,ENERGY

$$212 \text{ MBTU/yr} \times 0.5 = \underline{106 \text{ MBTU/yr}} \quad \text{ELEC}$$

COST

$$106 \text{ MBTU/yr} \times \$10.94/\text{MBTU} = \underline{\$1160/\text{yr}}$$



SUBJECT LEAD ECO #11  
DESIGNER \_\_\_\_\_  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 5 OF 5  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

SUMMARY  
SAVINGS

<u>BLDG</u>	<u>BOOTH</u>	<u>ENERGY</u> <u>(MBTU/ELEC/L)</u>	<u>ENERGY</u> <u>COST SAVINGS</u> <u>(\$)</u>
350	49	458	5010
350	50	583	6380
350	2544	458	5010
37	-	106	1160
TOTAL		1,610	17,600

CONSTRUCTION COST

FOR ALL 4 BOOTHS = \$6530

PAY BACK

$$\frac{\$7280}{\$17600/\text{YR}} = 0.41 \text{ YRS.}$$

QRIP Calc's

$$\begin{aligned} \text{Current energy use: } & \$10,000 + \$12,800 + \$12,800 + \$2319 \\ & = \$37,919 \end{aligned}$$



05/09/91

ECO Construction Cost Estimate  
Calculations

ECO Name: Building 350 & 37 blast booth fan control

ECO #: 11

1991 ECO "bare" costs (from cost estimate sheet)

Material	\$1,150
Labor	\$2,850

Subtotal bare costs	\$4,000
---------------------	---------

FICA Insurance (20% of Labor)	\$570
-------------------------------	-------

Sales Tax (6.5% of Material)	\$75
------------------------------	------

Subtotal	\$4,645
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Overhead (15%)	\$697
----------------	-------

Subtotal	\$5,342
----------	---------

Profit (10%)	\$534
--------------	-------

Subtotal	\$5,876
----------	---------

Bond (1%)	\$59
-----------	------

Subtotal	\$5,935
----------	---------

Contingency (10%)	\$594
-------------------	-------

Subtotal (Construction Cost Input For LCCID *)	\$6,529
--	---------

SIOH (5.5% of Construction Cost)	\$359
----------------------------------	-------

Subtotal	\$6,888
----------	---------

Design (6% of Construction Cost)	\$392
----------------------------------	-------

Total Project Cost	\$7,280
--------------------	---------

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.



SUBJECT LETTER KENNY Army DEP.

AEP NO \_\_\_\_\_

SHEET \_\_\_\_\_ OF \_\_\_\_\_

DESIGNER \_\_\_\_\_

G. Fallon

DATE \_\_\_\_\_

CHECKER \_\_\_\_\_

DATE \_\_\_\_\_

ECO #12

SAMPLE CALCULATIONS FOR PAYBACK ON FUEL SWITCH FROM NO. 2 F.O. TO NO. 5 F.O.

BLDG. 2 1990 #2 F.O. CONSUMPTION = 74,632 gal

ENERGY RELEASED (FUEL CONSUMPTION DATA - LEAD FUEL CONSUMPTION REPORT, 1990)

$$74632 \times 0.138690 \text{ MBTU/gal} = 10,400 \text{ MBTU/yr}$$

COST OF NO. 2 FUEL

$$10,400 \text{ MBTU/yr} \times \$7.43/\text{MBTU} = \$76,900/\text{yr}$$

COST OF EQUIV. NO. 5 FUEL OIL

$$10400 \text{ MBTU/yr} \times \$6.61/\text{MBTU} = \$68,400/\text{yr}$$

COST SAVING

$$\$76,900 - \$68,400 = \$8,500/\text{yr}$$

CONSTRUCTION COST

$$\$12,495 \text{ per BOILER} \times 2 \text{ BOILERS/BLDG} = \$25,000$$

PAYBACK

$$\frac{\$25,000}{\$8,500/\text{yr}} = 2.94 \text{ YRS.}$$

THE ABOVE CALCULATIONS WERE USED IN SPREADSHEET SOFTWARE TO CALCULATE THE PAYBACK FOR EACH OF THE BOILER ROOMS. THE RESULTS ARE ON THE SUMMARY SHEET.

LETTERKENNY ARMY DEPOT  
BOILER FUEL CONVERSION FROM  
NUMBER 2 F.O. TO NO 5 F.O.  
SUMMARY

## FUEL BTU VALUES

FUEL OIL NUMBER	BTU CONTENT (BTU/GAL)	FUEL COST (\$/GAL)	FUEL COST (\$/MBTU)
2	138,690	\$1.03	\$7.43
5	149,690	\$0.99	\$6.61

## R E C O M M E N D E D

BLDG NO.	FUEL TYPE (NO)	ANNUAL CONSUMP (GAL)	ANNUAL CONSUMP (MBTU)	ANNUAL COST (\$/YR)	ANNUAL \$5 COST (\$/YR)	ANNUAL SAVINGS (\$/YR)	NO BLRS PER BLDG (NO)	COST PER BLR HOUSE (\$)	PAYBACK (YRS)
2	2	74632	10351	\$76,871	\$68,456	\$8,415	2	\$24,990	3.0
320	2	63295	8778	\$65,194	\$58,057	\$7,137	2	\$24,990	3.5
37HP	2	49993	6934	\$51,493	\$45,856	\$5,637	2	\$24,990	4.4
8	2	46446	6442	\$47,839	\$42,603	\$5,237	2	\$24,990	4.8
Total		234366	32504	\$241,397	\$214,972	\$26,425	8	\$99,960	3.8

## N O T R E C O M M E N D E D

BLDG NO.	FUEL TYPE (NO)	ANNUAL CONSUMP (GAL)	ANNUAL CONSUMP (MBTU)	ANNUAL COST (\$/YR)	ANNUAL \$5 COST (\$/YR)	ANNUAL SAVINGS (\$/YR)	NO BLRS PER BLDG (NO)	COST PER BLR HOUSE (\$)	PAYBACK (YRS)
3751	2	11119	1542	\$11,453	\$10,199	\$1,254	1	\$12,495	10.0
4756	2	9576	1328	\$9,863	\$8,784	\$1,080	1	\$12,495	11.6
10	2	13704	1901	\$14,115	\$12,570	\$1,545	2	\$24,990	16.2
5249	2	6550	908	\$6,747	\$6,008	\$739	1	\$12,495	16.9
3810	2	13027	1807	\$13,418	\$11,949	\$1,469	2	\$24,990	17.0
2360	2	12634	1752	\$13,013	\$11,589	\$1,424	2	\$24,990	17.5
3626	2	5778	801	\$5,951	\$5,300	\$651	1	\$12,495	19.2
3700	2	5109	709	\$5,262	\$4,686	\$576	1	\$12,495	21.7
1466	2	9338	1295	\$9,618	\$8,565	\$1,053	2	\$24,990	23.7
5647	2	4372	606	\$4,503	\$4,010	\$493	1	\$12,495	25.3
5250	2	2644	367	\$2,723	\$2,425	\$298	1	\$12,495	41.9
5313	2	2510	348	\$2,585	\$2,302	\$283	1	\$12,495	44.2
2755	2	4293	595	\$4,422	\$3,938	\$484	2	\$24,990	51.6
3812	2	2116	293	\$2,179	\$1,941	\$239	1	\$12,495	52.4
3311	2	1979	274	\$2,038	\$1,815	\$223	1	\$12,495	56.0
2702	2	1601	222	\$1,649	\$1,469	\$181	1	\$12,495	69.2
4341	2	1540	214	\$1,586	\$1,413	\$174	1	\$12,495	72.0
3321	2	1185	164	\$1,221	\$1,087	\$134	1	\$12,495	93.5
3387	2	909	126	\$936	\$834	\$102	1	\$12,495	121.9
3170	2	137	19	\$141	\$126	\$15	1	\$12,495	808.9

05/09/91

ECO Construction Cost Estimate  
Calculations

ECO Name: Boiler conversion to No5 fuel oil

ECO #: 12

1991 ECO "bare" costs (from cost estimate sheet)		
Material		\$5,120
Labor		\$2,101
	Subtotal bare costs	\$7,221
FICA Insurance (20% of Labor)		\$420
Sales Tax (6.5% of Material)		\$333
	Subtotal	\$7,974
Overhead (15%)		\$1,196
	Subtotal	\$9,170
Profit (10%)		\$917
	Subtotal	\$10,087
Bond (1%)		\$101
	Subtotal	\$10,188
Contingency (10%)		\$1,019
		+-----+
Subtotal (Construction Cost Input For LCCID *)		\$11,207
		+-----+
SIOH (5.5% of Construction Cost)		\$616
	Subtotal	\$11,823
Design (6% of Construction Cost)		\$672
		-----
Total Project Cost		\$12,495

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.



since 1939

6855 Phillips Parkway Drive South • Jacksonville, Florida 32256

904/262-4700 • FAX 904/262-4604

# ILLINGWORTH ENGINEERING COMPANY

manufacturers agent

May 2, 1991

Reynolds, Smith & Hills  
4651 Salisbury Road  
Jacksonville, Florida 32256  
ATTN: Mr. George Fallin

Dear Mr. Fallin:

Concerning your conversation with John Ring, I am sending you an estimated figure for the total of parts and labor to perform an oil conversion on the following:

60" Cleaver-Brooks Boiler.....	\$12,495.00
If required, add for No. 6 oil heater.....	\$1,431.25
78" Cleaver-Brooks Boiler.....	\$13,900.00
If required, add for No. 6 oil heater.....	\$3,256.25
96" Cleaver-Brooks Boiler.....	\$15,110.00
If required, add for No. 6 oil heater.....	\$6,581.25

Please bear in mind, the prices listed above are just estimated figures and are not meant to be used as a hard copy quote.

I have based these figures on the diameter size of the boiler only. Pricing may vary according to the model and serial number of the unit.

The labor included is for the installation of the conversion kit only and does not reflect any other extended work or travel time.

I hope this information will be useful to you. If we can help you any further, please feel free to call.

Sincerely,

Dewayne L. Drinnon  
Parts Department

ECO # 13

Install Energy Efficient lamps in Building 370

Assumptions:

1. The lights in the casing repair area are on for two shifts, 5 days per week (4,160 hrs/yr)
2. The existing fixtures and ballasts will remain in place.
3. There are no ballast savings when changing to 34-watt lamps.

Current energy consumption:

$$450 \text{ fixtures} \times 4 \frac{\text{lamps}}{\text{fixture}} \times 40 \frac{\text{watts}}{\text{lamp}} \times \frac{1 \text{ kw}}{1000 \text{ w}} = 72 \text{ kw}$$

$$72 \text{ kw} \times 4160 \text{ hrs/yr} = 299,520 \text{ kwh/yr}$$

Energy consumption with 34-watt lamps:

$$450 \text{ fixt.} \times 4 \frac{\text{lamp}}{\text{fix}} \times 34 \frac{\text{watt}}{\text{lamp}} \times \frac{1 \text{ kw}}{1000 \text{ w}} = 61.2 \text{ kw}$$

$$61.2 \text{ kw} \times 4160 \text{ hr/yr} = 254,592 \text{ kwh/yr}$$

Energy Savings:

$$299,520 \text{ kwh/yr} - 254,592 \text{ kwh/yr} = \underline{44,928 \text{ kwh/yr}}$$

$$44,928 \frac{\text{kwh}}{\text{yr}} \times 3413 \frac{\text{Btu}}{\text{kwh}} \times \frac{1 \text{ MBtu}}{10^6 \text{ Btu}} = \underline{153.3 \text{ MBtu/yr}}$$

Energy Cost Savings =

$$44,928 \frac{\text{kwh}}{\text{yr}} \times \$0.0373 / \text{kwh} = \underline{\$1676 / \text{year}}$$

Project Cost:

$$\text{Total project cost} = \underline{\$20,502}$$

See cost estimate sheets for details

Simple Payback:

$$\text{Payback} = \text{Cost} \div \text{Savings} = \$20,502 \div \$1,676 / \text{yr}$$

$$\underline{\text{Payback} = 12.2 \text{ years}}$$



05/14/91

ECO Construction Cost Estimate  
Calculations

ECO Name: Energy Efficient Lamps In Building 370

ECO #: 13

1991 ECO "bare" costs (from cost estimate sheet)		
Material		\$5,490
Labor		\$6,030
	Subtotal bare costs	\$11,520
FICA Insurance (20% of Labor)		\$1,206
Sales Tax (6.5% of Material)		\$357
	Subtotal	\$13,083
Overhead (15%)		\$1,962
	Subtotal	\$15,045
Profit (10%)		\$1,505
	Subtotal	\$16,550
Bond (1%)		\$166
	Subtotal	\$16,716
Contingency (10%)		\$1,672
		+-----+
Subtotal (Construction Cost Input For LCCID *)		\$18,388
		+-----+
SIOH (5.5% of Construction Cost)		\$1,011
	Subtotal	\$19,399
Design (6% of Construction Cost)		\$1,103
		-----
Total Project Cost		\$20,502

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.



ECO # 14

## Energy Efficient Frequency Converters in Building 370

### Assumptions:

1. The converters operate near full load for 1 shift, 50% load for 1 shift and at no load on nights and weekends.
2. The operating efficiencies of solid state and motor-generator type frequency converters are:

	<u>Solid State</u>	<u>Motor-gen.</u>
Full load eff.	94%	85%
50% load eff.	92%	70%

Source: Teledyne Inet telcon

3. The no load KW input is calculated using the following equation =

$$KW_{NL} = [KW_{FL} - (KW_{FL} \times EFF_{FL})] \times 0.80$$

Source: Teledyne Inet and Controlled Systems

### Calculations:

The output rating for the existing motor-generator type frequency converters is 60 kw.

$$\text{Full load KW input} = 60 \text{ kw} \div 0.85 = 70.6 \text{ kw}$$

Frequency Converters (Continued):

$$50\% \text{ load Kw input} = 60 \text{ kw} \times .5 \div 0.70 = 42.9 \text{ kw}$$

$$\text{No load Kw input} = [60 \text{ kw} - (60 \text{ kw} \times .85)] \times 0.8$$

$$\text{Kw}_{NL} = 7.2 \text{ kw}$$

Current energy use =

$$1\text{st Shift} = 70.6 \text{ kw} \times 2080 \text{ hr/yr} = 146,848 \text{ kwh/yr}$$

$$2\text{nd Shift} = 42.9 \text{ kw} \times 2080 \text{ hr/yr} = 89,232 \text{ kwh/yr}$$

$$\text{Nights/Wkends} = 7.2 \text{ kw} \times 4600 \text{ hr/yr} = 33,120 \text{ kwh/yr}$$

$$\text{Total} = 146,848 + 89,232 + 33,120 = \underline{269,200 \text{ kwh/yr}}$$

Current energy cost :

$$\text{Cost} = 269,200 \text{ kwh/yr} \times 0.0373 \text{ \$/kwh} = \underline{\$10,041/\text{yr}}$$

Energy use for a 60 kw Solid State frequency Converter:

$$\text{Full load Kw input} = 60 \text{ kw} \div 0.94 = 63.8 \text{ kw}$$

$$50\% \text{ load Kw input} = 60 \text{ kw} \times .5 \div 0.92 = 32.6 \text{ kw}$$

$$\text{No load Kw input} = [60 \text{ kw} - (60 \text{ kw} \times .94)] \times .8$$

$$\text{Kw}_{NL} = 3.6 \text{ kw} \times .8 = 2.9 \text{ kw}$$

Frequency Converters (Continued):

$$1st \text{ Shift} = 63.8 \text{ kw} \times 2080 \text{ hr/yr} = 132,704 \text{ kwh/yr}$$

$$2nd \text{ Shift} = 32.6 \text{ kw} \times 2080 \text{ hr/yr} = 67,808 \text{ kwh/yr}$$

$$\text{Nights/Wkends} = 2.9 \text{ kw} \times 4600 \text{ hr/yr} = 13,340 \text{ kwh/yr}$$

$$\text{Total} = 132,704 + 67,808 + 13,340 = \underline{213,852 \text{ kwh/yr}}$$

$$\text{Cost} = 213,852 \text{ kwh/yr} \times 0.0373 \text{ \$/kwh} = \underline{\$7977/\text{yr}}$$

Energy savings by converting from motor-generator type to solid state frequency converters:

$$269,200 \text{ kwh/yr} - 213,852 \text{ kwh/yr} = 55,348 \frac{\text{kwh}}{\text{year}} \text{ per unit}$$

$$55,348 \text{ kwh/yr} \cdot \text{unit} \times 3 \text{ units} = \underline{166,044 \text{ kwh/yr}} = \underline{\underline{567 \text{ MWh/yr}}}$$

Cost Savings:

$$\$10,041/\text{yr} - \$7977/\text{yr} = \$2,064/\text{yr} \cdot \text{unit}$$

$$\$2,064/\text{yr} \cdot \text{unit} \times 3 \text{ units} = \underline{\$6,192/\text{yr}}$$

Construction Cost:

$$\text{Project Cost} = \underline{\$155,842} \quad (\text{See cost estimate sheet})$$

Simple Payback:

$$\$155,842 \div \$6,192/\text{yr} = \underline{25.2 \text{ years}}$$



SUBJECT ECO # 14 - Frequency  
Converters  
 DESIGNER P. H. H. H. H. H.  
 CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
 SHEET \_\_\_\_\_ OF \_\_\_\_\_  
 DATE 10/1/91  
 DATE \_\_\_\_\_

# MAINTENANCE COSTS - LEAD

<u>TYPE</u>	<u>AGE</u>	<u>MAINTENANCE</u>	
		<u>TOTAL</u>	<u>ANNUAL</u>
SOLID STATE	2	\$ 25	\$ 13
	2	0	0
	2	9000	4500
	1	1471	1471
	3	4045	1348
	3	1461	487
	3	1627	542
	3	1402	467
	<u>3</u>	<u>1800</u>	<u>600</u>
TOT	22	\$ 20,831	\$ 9428

<u>(continued)</u>				
<u>Rotary</u>	<u>AGE</u>	<u>TOTAL</u>	<u>AGE</u>	<u>TOTAL</u>
↓	6	\$ 1861	21	5570
	6	2235	33	2236
	6	884	10	4382
	6	1377	9	2056
	22	7621	7	2819
	12	4571	<u>6</u>	<u>2200</u>
	16	9214	TOT 259	\$ 68,449
	16	6884		
	16	3416		
	15	2848		
	21	4451		
	31	3824		

Avg annual maintenance

Solid state - \$ 9428  
 Rotary - \$ 264

# FREQUENCY CONVERTORS MAINTENANCE DATA

LETTERKEY I.D. NO.	TYPE	MANUFACTURE	ACQ. COST.	TOTAL MAINT. COST.	PURCHASE DATE
L6208	SOLID STATE	PACIFIC POWER	22560-	25.-	89 NEW
LN6409	SOLID STATE	HUNTINGTON BERN.	23481-	0-	89 NEW
LM6547	" "	CALIFORNIA	214349-	Est. 9000.-	89 NEW
N9308	" "		388907-	1471.-	90 NEW
M6989	" "	CONTROLLED SYS.	24787-	4045.-	88 NEW
m6990	" "	FAIRMONT WVA.	24787-	1461-	88 NEW
m6991	" "		24787-	1627-	88 NEW
m6992	" "		24787-	1402-	88 NEW
m6993	" "		24787-	1800-	88 NEW
5301	ROTARY	KATO MFG.	51300-	1861-	85 NEW
5302	"	MANKATO MINN.	51300-	2235-	85 NEW
5303	"		51300-	884-	85 NEW
5304	"		51300-	1377-	85 NEW
3022	"	HOLLINGSWORTH	9144-	7621	59
3023	"	"	8840-	4571	69
3381	"	"	9046-	9214	75 Rebuilt
3383	"	"	9046-	6884	75 Rebuilt
3386	"	"	9046-	3416	75 Rebuilt
3575	"	"	9046-	2848	76 Rebuilt
3838	"	"	9046	4451	70 Rebuilt
4027	"	"	9046-	3824	60 Rebuilt
4034	"	"	9046-	5570	70 Rebuilt
4450	"	"	9046-	2236	58 Rebuilt
4675	"	"	9046-	4382	81 Rebuilt
4767	"	"	9046-	2056	82 Rebuilt
5288	"	"	9046-	2819	84 Rebuilt
5362	"	"	9046-	2204	85 Rebuilt

05/14/91

ECO Construction Cost Estimate  
Calculations

ECO Name: Energy Efficient Frequency Converters For Building 370

ECO #: 14

1991 ECO "bare" costs (from cost estimate sheet)		
Material		\$90,000
Labor		\$3,000
	Subtotal bare costs	\$93,000
FICA Insurance (20% of Labor)		\$600
Sales Tax (6.5% of Material)		\$5,850
	Subtotal	\$99,450
Overhead (15%)		\$14,918
	Subtotal	\$114,368
Profit (10%)		\$11,437
	Subtotal	\$125,805
Bond (1%)		\$1,258
	Subtotal	\$127,063
Contingency (10%)		\$12,706
		+-----+
Subtotal (Construction Cost Input For LCCID *)		\$139,769
		+-----+
SIOH (5.5% of Construction Cost)		\$7,687
	Subtotal	\$147,456
Design (6% of Construction Cost)		\$8,386
		-----
Total Project Cost		\$155,842

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.



## CONSTRUCTION COST ESTIMATE

DATE PREPARED

4-15-91

SHEET

OF

PROJECT

ENERGY ENGINEERING ANALYSIS

LOCATION

Letterkenny

ARCHITECT ENGINEER

REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE

- ☒ CODE A (No design completed)  
☐ CODE B (Preliminary design)  
☐ CODE C (Final design)  
☐ OTHER (Specify) \_\_\_\_\_

DRAWING NO.

ESTIMATOR

W.T. Todd

CHECKED BY

Solid State F.C.'s SUMMARY

QUANTITY

NO.  
UNITSUNIT  
MEAS.

LABOR

PER  
UNIT

TOTAL

MATERIAL

PER  
UNIT

TOTAL

TOTAL  
COST

60 kw output, solid  
state frequency  
converter

3

EA

1000

3000

30000

90000

\$93,000

Source: Teledyne Inet (Vendor) telephone conversation

Project No. 290-0379-001Local (L.D.) Placed                      Rec'd.                      Date 3/15/91W. Todd                      Conversed With Mike Sever (Atlanta)  
Of Teledyne Inet Regarding Frequency Converters  
404/952-7363

Motor-generator units ~ 60 kw

Cost \$30,000 - \$35,000

MTBF = 40,000 hours for horizontal shaft (bearings fail)

MTBF = 150,000 hours for vertical shaft

Full load eff ~ 85%

1/2 load eff ~ 79%

No load Kw =  $[60 - (60 \times .85)] \times 0.8 = 7.2$ 

Solid State units ~ 60 kw

Cost ~ \$30,000

MTBF = 12,000 to 18,000 hours (printed circuit boards fail)

Full load eff = 94%

1/2 load eff = 92%

No load Kw =  $[60 - (60 \times .94)] \times 0.8 = 2.9$ 

Distribution:

## OPERATING COSTS

Operating costs are just as important as initial capital costs. Let us compare only two 50KVA/40KW 400Hz solid state units (as required by a single 3090-400) with equivalent motor generator type units as follows (assume both are running at 70% load which is very typical):

	<u>SOLID STATE</u>	<u>ROTARY MG</u>
Rating of each unit	50KVA/40KW	50KVA/40KW
Output KW (rated)	2 X 40KW	2 X 40KW
Output KW (operating)	2 X 28	2 X 28
Efficiency at operating KW	.92	.73
Input KW (output/eff)	60.87	76.71
KW-hrs per year	533221	671980
Utility Bill @ \$0.10/KW-hr	\$53,322.1	\$67,198.0

It is therefore clear that the difference in operating costs is  $\$67,198 - \$53,322 = \$13,876$  for only a single computer!

If 5 such CPU's are needed, the 10-year savings are \$693,800.00 -- no small change! In fact the net 10-year savings far exceeds the initial total purchase cost of the 10 solid state units (2 per CPU).

The above calculations do not take into account that the user also needs to put in additional HVAC equipment in the computer room to handle the extra heat dissipated by the 10 MG's.

How much capacity would you need? This is a simple calculation. Simply multiply the difference in input KW's ( $76.71 - 60.87 = 15.84\text{KW}$ ) by 3412 to get the BTU's per hour (54,046). This number divided by 12,000 yields the required HVAC tonnage i.e.  $54,046/12000 = 4.5$  tons. For 5 CPU's you would need 22.8 tons of additional cooling not to mention the extra electric power needed to run the additional cooling units continuously.

The bottom line therefore is that the operating costs are not just reflected in your utility bills every month, they also require additional capital expense for extra cooling units, additional electric power used by the cooling units, as well as additional space for such in the computer room.



ECO #14

## **Controlled Systems**

Incorporated

1106 Chamberlain • Fairmont, W. Va. 26554 • 304/366-5144 • Fax: 304/366-5231

April 3, 1991

R S & H  
4651 Salisbury Road  
Jacksonville, FL 32256

ATTN: Bill Todd

RE: Frequency Converter Info.

Dear Mr. Todd:

Pursuant to our recent conversation, please find the enclosed product literature which includes our solid state frequency converter. As I stated during our conversation, the efficiency of our units is normally 90% or greater. Efficiency of a motor generator set usually runs between 60 and 85% efficient, depending on the load of the generator. With no load on a generator a great deal of energy is wasted. With a CSI solid state unit with no load loss would be around 5%. Using solid state units there are no moving parts to wear out, no bearings to grease or oil to change as in motor generator sets. This alone could save maintenance cost and down time.

If I can be of any further assistance please do not hesitate to contact me. Thank you for your interest in Controlled Systems Solid State Frequency Converters.

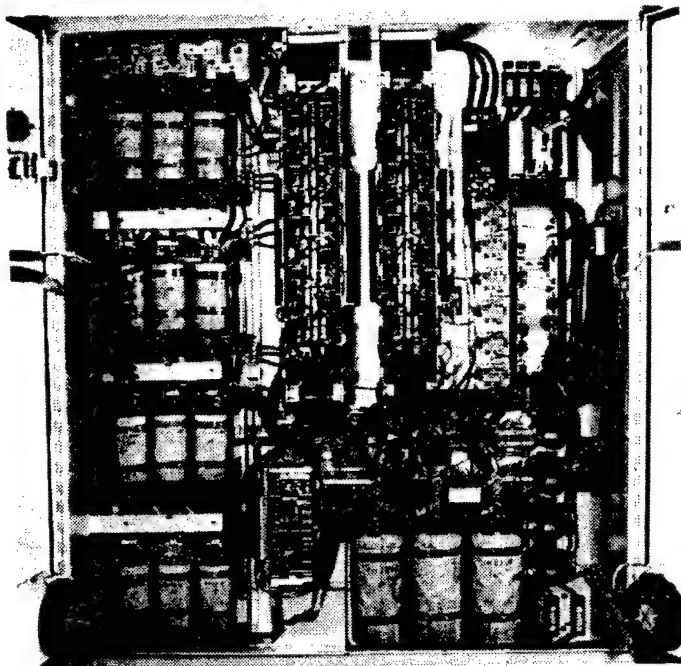
Sincerely,

CONTROLLED SYSTEMS, INC.

Frank Pazdric  
Assistant Sales Manager

cjm

# SOLID STATE FREQUENCY CONVERTERS



Indoor, 90 KVA unit for radar application

## SPECIFICATIONS

Input Voltage - 3 phase, optional 208 to 600VAC  $\pm 10\%$ , 50 or 60HZ  
 Input Frequency - 50 or 60HZ  
 Input Protection - Overcurrent, short circuit, phase loss, phase sequence, over/under voltage  
 Output Power Rating -  $7\frac{1}{2}$ -600KVA, based on a power factor of 0.8 lagging  
 Output Voltage - 1 phase or 3 phase, wye or delta, optional 115 to 600 VAC  
 Output Frequency - 50, 60, or 400 Hz. Other frequencies available upon request  
 Voltage Adjustment - Standard,  $\pm 15\%$  of rated output  
 Frequency Stability -  $\pm .01\%$  over full temperature range (unaffected by load)  
 Frequency Transients - None  
 Voltage Regulation -  $\pm 1\%$   
 Voltage Modulation - Does not exceed 1% with a stable rated load  
 Phase Separation -  $120^\circ \pm 1\%$  for balanced load  
 $120^\circ \pm 4\%$  for 33% unbalanced load  
 Crest Factor -  $1,414 \pm 5\%$   
 Voltage Transient Response - IAW MIL-STD 704D and DOD-STD-1399  
 Total Harmonic Distortion - IAW MIL-STD-704D  
 Typically ~~2.0%~~ **1.5%**  
 Overload Capacity - 125% ~~continuous~~ **1HR**, 150% for 5 minutes, 200% for 10 seconds  
 Protection - Electronic overload, short circuit, over/under voltage  
 Efficiency - ~~95%~~ at full load, 90% ~~continuous~~  
 No load losses - Less than 5% of rated output power

The Controlled Systems' Solid State Power Supply converts 3 phase 50 or 60Hz input power to 3 phase fixed frequency sinusoidal output with very low distortion. Applications include power for aircraft, computers, radar, lasers, avionics labs, welders, test stands, UPS, and OEM equipment.

## STANDARD FEATURES

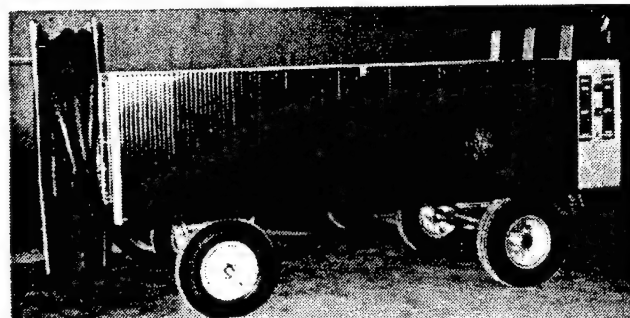
Input circuit breaker with enclosure door interlock  
 Door mounted  $\pm 15\%$  output voltage trim  
 Door mounted Start and Stop/Reset pushbuttons  
 Door mounted indicators - 1. Input Power ON  
 2. Run Condition  
 3. Fault (overload)  
 4. Output Under voltage  
 5. Output Over voltage  
 6. Load ON  
 Output voltmeter with 3 phase select switch  
 Output ammeter with 3 phase select switch  
 Input/output isolation  
 Digital display and LED diagnostic indicators to aid trouble shooting  
 Heatsink over-temperature protection  
 Modular construction  
 High efficiency ~~95%~~ **90%** at full load

## STANDARD OPTIONS

Automatic multiple unit paralleling  
 Auto line drip compensation  
 Auto-Restart  
 Expanded operating temperature range —  $40^\circ\text{C}$  to  $+50^\circ\text{C}$   
 Output circuit breaker w/shunt trip protection  
 Audible alarm and alarm silence button  
 Output frequency meter - Analog or Digital  
 Elapsed time meter  
 Input voltmeter with 3 phase select switch  
 Input ammeter with 3 phase select switch  
 $\pm 10\%$  output frequency trim  
 Sound absorption material for even lower audible noise  
 Dual isolated outputs, single voltage  
 Dual voltage outputs  
 Acoustical Noise - Less than 70 DBA at 1 meter  
 Operating Temperature Range -  $0^\circ$  to  $40^\circ\text{C}$  standard  
 $-40^\circ\text{C}$  to  $+50^\circ\text{C}$  optional  
 Humidity - 0 to 95% non-condensating  
 Altitude - 5,600 feet maximum  
 Cooling - Forced or natural convection  
 Enclosure Configurations - upright (shown above), mobile low profile flatback (shown below) or low profile flatpack suitable for fixed mounting.  
 Other configurations available.

Enclosure Types - Nema 3R, 4, 4X or 12

Dimensions and Weight - refer to Controlled Systems.



Hand Towable 60 KVA flatpack unit for hanger application.

Project No. 290-0379-001

Local \_\_\_\_\_ L.D. ✓ Placed \_\_\_\_\_ Rec'd. ✓ Date 10/8/91

P. Hutchins \_\_\_\_\_ Conversed With Brad Cook

Of LEAD - Elec. Maint-Production Regarding Frequency Convertors

- BC has maintenance data for FCs that he will fax to me

- Kato rotary type is their most reliable

- Solid state - Controlled Systems - not good clean source  
 - Pacific Power - very good, but prints are proprietary so co. must do maint.

Distribution:

SUBJECT Modular Offices

LEAD

DESIGNER W.T. Todd

CHECKER P. Hutchins

AEP NO 290-0379-001.

SHEET 1 OF

DATE 4/13/91

DATE Rev. 9-25-91

ECO # 15

Modular offices for personnel in Buildings 65, 8 & 9

### Assumptions:

1. The indoor temperature for these warehouses is currently maintained at 68°F.
2. The heating for these buildings is provided by the boilers in building 8, which burn Fuel oil #2.
3. The operation hours for these buildings are 8 hours per day, 5 days per week (2080 hrs/yr.)
4. The warehouse temperature can be reduced to 55°F while maintaining 68°F in the modular offices.
5. The modular offices will also be cooled to 75°F during the summer months.
6. The average indoor temperature during the summer months is currently about 80°F.
7. Since the wall and roof U-values and the infiltration rate do not change, the heat losses from the buildings is determined by the indoor-outdoor temperature difference and the amount of time heating is required.

Current energy consumption:

Annual fuel oil deliveries\*:  
FY 87 = 71,478 gal/yr  
FY 88 = 63,607  
FY 89 = 27,283  
FY 90 = 46,446

Total 208,814 gal/4 years

\* From Letterkenny Army Depot, Fuel Consumption Report,  
Building 8 boilers.

$$\text{Average fuel oil consumption} = \frac{208,814 \text{ gal}}{4 \text{ years}} = 52,203 \text{ gal/yr}$$

Buildings 6, 8 and 9 are approximately the same size so the energy use for each building is about:

$$52,203 \text{ gal/yr} \div 3 = 17,401 \text{ gal/yr per building}$$

$$17,401 \text{ gal/yr} \times 0.13869 \frac{\text{MBtu}}{\text{gal}} = 2413 \text{ MBtu/yr per bldg.}$$

$$\text{TOTAL USE FOR ALL BLDGS} = 2413 \times 3 = 7239 \text{ MBtu/yr}$$

Energy Savings:

Bin temperature data were used to calculate the potential energy savings when the indoor temperature is reduced from 68°F to 55°F.

From the spreadsheet calculations the sum of the (indoor temperature - average outdoor temperature) x hours of occurrence for 68°F is: 153,752 degree hours per year

This value corresponds to the total current energy use.



The degree hours for 55°F indoor temperature is =

82,338 degree hours

$$\text{Energy savings} = \frac{153,572 \text{ deg hrs} - 82,338 \text{ deg hrs}}{153,572 \text{ deg hrs}} = 0.46$$

$$\text{Energy Savings} = 2413 \frac{\text{MBtu}}{\text{yr}} \times 0.46 = \underline{1110 \frac{\text{MBtu}}{\text{yr}}} \text{ ea. for bldgs. 8 \& 9}$$

Additional Energy Use: Savings for bldg. 6s will be 50% of the above value since half the bldg. is offices.

To maintain office temperature an electric a/c and heating unit will be utilized. Its energy use is:

$$Q = VA\Delta T$$

$U_{\text{wall}} =$	air film	$R = 0.68$	} From 1989 ASHRAE Fund.
	1/8" hardboard	$R = 0.125 \div 1.2 = 0.10$	
	3" air space	$R = 0.90$	
	1/8" hardboard	$R = 0.10$	
	air film	$R = 0.68$	

$$R_T = 2.46$$

$$U_w = \frac{1}{R_T} = 0.41 \text{ Btu/hr.ft}^2.\text{°F}$$

$$U_{\text{window}} = 1.10 \text{ Btu/hr.ft}^2.\text{°F} \quad (1989 \text{ ASHRAE Fundamentals})$$

$U_{\text{ceiling}} =$	air film	$R = 0.76$	} From 1989 ASHRAE Fund.
	1/2" Acc. Tile	$R = 1.25$	
	air film	$R = 0.76$	
		$R_T = 2.77$	

$$U_{\text{ceiling}} = \frac{1}{R_T} = 0.36 \text{ Btu/hr.ft}^2.\text{°F}$$

$$\text{Wall area} = A_w = (10' \times 9' + 12' \times 9') \times 2 = 352 \text{ ft}^2 - A_{wi}$$

$$\text{Window area} = A_{wi} = 3' \times 5' \times 6 = 54 \text{ ft}^2$$

$$\text{Ceiling area} = A_c = 10' \times 12' = 120 \text{ ft}^2$$

$$Q = U_w \times A_w \times \Delta T + U_{wi} \times A_{wi} \times \Delta T + U_c \times A_c \times \Delta T$$

$$\Delta T_w = 69^\circ\text{F} - 55^\circ\text{F} = 13^\circ\text{F} \quad \text{winter}$$

$$\Delta T_s = 80^\circ\text{F} - 75^\circ\text{F} = 5^\circ\text{F} \quad \text{summer}$$

$$Q = (0.41 \times 298 + 1.10 \times 54 + 0.36 \times 120) \frac{\text{Btu}}{\text{hr} \cdot ^\circ\text{F}} \times \Delta T$$

$$Q_s = 224.8 \frac{\text{Btu}}{\text{hr} \cdot ^\circ\text{F}} \times 5^\circ\text{F} = 1124 \text{ Btu/hr}$$

$$Q_w = 224.8 \frac{\text{Btu}}{\text{hr} \cdot ^\circ\text{F}} \times 13^\circ\text{F} = 2922 \text{ Btu/hr}$$

$$\text{Heating hours} = 1,465 \text{ hours/year (From bin data)}$$

$$\text{Heating energy} = 1465 \frac{\text{hr}}{\text{yr}} \times 2922 \frac{\text{Btu}}{\text{hr}} = 4.3 \frac{\text{MBtu}}{\text{yr}}$$

$$4.3 \frac{\text{MBtu}}{\text{yr}} \times 10.94 \frac{\$}{\text{MBtu}} = \$47/\text{year}$$

$$\text{Cooling hours} = 9 \frac{\text{hr}}{\text{day}} \times 260 \frac{\text{day}}{\text{yr}} - 1465 \frac{\text{hr}}{\text{yr}} = 875 \text{ hr/yr}$$

$$\text{Cooling efficiency: assume an EER of } 8 \frac{\text{Btu}}{\text{watt}}$$

$$\text{Cooling energy} = 1124 \frac{\text{Btu}}{\text{hr}} + 1500 \text{ w} \times \frac{3.413 \text{ Btu/hr (appliance \& people load)}}{\text{w}} = 6224 \frac{\text{Btu}}{\text{hr} \cdot \text{Bldg}}$$

$$\text{Cooling energy} = 6224 \frac{\text{Btu}}{\text{hr}} \div 8 \frac{\text{Btu}}{\text{w}} \times \frac{1 \text{ kw}}{1000 \text{ w}} \times 875 \frac{\text{hr}}{\text{yr}} = 683 \frac{\text{kwh}}{\text{yr} \cdot \text{Bldg}}$$

$$\text{Cooling energy} = 683 \frac{\text{wh}}{\text{yr}} \times \frac{3413 \text{ Btu}}{\text{wh}} \times \frac{\text{MBtu}}{10^6 \text{ Btu}} = 2.3 \frac{\text{MBtu}}{\text{yr} \cdot \text{Bldg}}$$

$$2.3 \frac{\text{MBtu}}{\text{yr}} \times 10.94 \frac{\$}{\text{MBtu}} = \underline{\underline{\$25 / \text{yr} \cdot \text{Bldg.}}}$$

$$\text{Total additional energy use} = \left( 4.3 \frac{\text{MBtu}}{\text{yr} \cdot \text{B}} + 2.3 \frac{\text{MBtu}}{\text{yr} \cdot \text{B}} \right) \times 3 \text{ Bld.} = \underline{\underline{20 \frac{\text{MBtu}}{\text{yr}}}}$$

$$\text{Total additional energy cost} = \left( 47 \frac{\$}{\text{yr} \cdot \text{B}} + 25 \frac{\$}{\text{yr} \cdot \text{B}} \right) \times 3 \text{ Bldg.} = \underline{\underline{\$216 / \text{yr}}}$$

Energy Cost Savings:

$$1110 \frac{\text{MBtu}}{\text{yr}} \times 4.98 \frac{\$}{\text{MBtu}} = \underline{\underline{\$5528 / \text{yr} \text{ for bldgs. 8 \& 9}}}$$

$$1110 \frac{\text{MBtu}}{\text{yr}} \times 4.98 \frac{\$}{\text{MBtu}} \times 0.5 = \underline{\underline{\$2764 / \text{yr} \text{ for bldg 65}}}$$

Net Energy Savings:	#2 Fuel oil	: $1110 \frac{\text{MBtu}}{\text{yr} \cdot \text{Bld.}} \times 2.5 \text{ Bld.} = 2775 \text{ MBtu/yr}$
	Elec	: $(4.3 + 2.3) \times 3 = (20) \text{ MBtu/yr}$

$$\text{Net Energy Savings} = \text{Energy Savings} - \text{Add. energy use}$$

$$= 2,775 \text{ MBtu/yr} - 20 \text{ MBtu/yr}$$

$$= \underline{\underline{2,755 \text{ MBtu/yr}}}$$

Net Energy Cost Savings:

$$\text{Net energy cost savings} = \$5528 / \text{yr} \times 2.5 \text{ Bldgs.} - \$216 / \text{yr}$$

$$= \underline{\underline{\$13,600 / \text{yr}}}$$

Project Cost :

Total Project Cost = \$26,037

See cost estimate sheets for details

Simple Payback :

Payback = Cost ÷ Savings

=  $\$26,037 \div \$13,600/\text{yr}$

Payback = 1.9 years

QRIP Calc's

Present energy use = 7239 MBtu/yr #2 fuel oil  
cost =  $7239 \times 4.98 = \$36,100/\text{yr}$

Proposed method = 4,464 MBtu/yr #2 fuel oil  
20 MBtu/yr electricity  
cost =  $4,464 \times 4.98 + 20 \times 10.94$   
= \$22,500

ENERGY AUDIT OF INDUSTRIAL FACILITIES  
LETTERKENNY ARMY DEPOT

Operation hours per day = 24  
Operation days per week = 7

Indoor Air Temperature (F) = 55

Hour Fractions:      1 AM - 9 AM      1  
                         9 AM - 5 PM      1  
                         5 PM - 1 AM      1

Temperature Range		Hours of Occurrence			Net Hours	Delta T	Total Deg Hrs	Net Deg Hrs
		2-9	10-17	18-1				
70	74	247	237	301	785	-17	0	0
65	69	296	217	278	791	-12	0	0
60	64	269	196	236	701	-7	0	0
55	59	249	191	209	649	-2	0	0
50	54	221	193	202	616	3	1,848	1,848
45	49	218	193	206	617	8	4,936	4,936
40	44	237	236	239	712	13	9,256	9,256
35	39	289	246	286	821	18	14,778	14,778
30	34	304	194	258	756	23	17,388	17,388
25	29	184	106	152	442	28	12,376	12,376
20	24	124	65	90	279	33	9,207	9,207
15	19	75	32	57	164	38	6,232	6,232
10	14	54	13	26	93	43	3,999	3,999
5	9	18	3	9	30	48	1,440	1,440
0	4	9	0	2	11	53	583	583
-5	-1	3	0	1	4	58	232	232
-10	-6	1	0	0	1	63	63	63
-15	-11	0	0	0	0	68	0	0
Totals		2798	2122	2552	7472		82338	82338

Total operation hours while heating  
corrected for working days/week = 4546 Hours/Yr

Total degree hours per year corrected for  
working days per week = 82338 Degree hours

Average outdoor temperature while heating = 36.9 F

05/14/91

ECO Construction Cost Estimate  
Calculations

ECO Name: Modular Offices For Buildings 6-South, 8 and 9

ECO #: 15

1991 ECO "bare" costs (from cost estimate sheet)		
Material		\$14,385
Labor		\$1,080
	Subtotal bare costs	\$15,465
FICA Insurance (20% of Labor)		\$216
Sales Tax (6.5% of Material)		\$935
	Subtotal	\$16,616
Overhead (15%)		\$2,492
	Subtotal	\$19,108
Profit (10%)		\$1,911
	Subtotal	\$21,019
Bond (1%)		\$210
	Subtotal	\$21,229
Contingency (10%)		\$2,123
		+-----+
Subtotal (Construction Cost Input For LCCID *)		\$23,352
		+-----+
SIOH (5.5% of Construction Cost)		\$1,284
	Subtotal	\$24,636
Design (6% of Construction Cost)		\$1,401
		-----
Total Project Cost		\$26,037

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.



GETCO, Inc.  
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Jacksonville, FL 32247-0432  
(904) 791-9042 Fax: (904) 358-3906

Ship To:

Bill To:

REYNOLDS, SMITH & HILL

6737 Southpoint Drive

JAX, FL 32216

ATTN: BILL TODD

Salesman:

DAN

Cust Contact:

BILL

Phone Number:

279-2281

Fax Number:

279-2491

Customer PO:

Date

4-12-91

Quote #

Order #

Inv #

Qty.	Unit	Stock #	Description	W	QTY.	Unit Total Wgt.	Unit Weight	Unit List	Total List	Disc.	Unit Cost	Total Cost	Unit Sell	Total Sell
1	EA		ET-120 10'x12' IN-PLANT											
			OFFICE BUILDING COMPLETE											
			WITH THE FOLLOWING:											
			1-STD. DOOR, 6-WINDOWS,											
			1-HVAC UNIT, 4-110V OUTLETS,											
			1-220V OUTLETS, 1-LIGHT SWITCH											
			2-4 TUBE FLUORESCENT FIXTURES,											
			1-4 CIRCUIT BREAKER BOX						469.00					4395.00
			ABOVE PRICE F.O.B. JACKSONVILLE, FL											
			ALLOW 3 WKS A.P.O. DELIVERY											
			Delivery Charges											

New and Used Warehouse Equipment  
Sales and Service

GETCO, INC.

Dan Caswell

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Jacksonville, Florida 32247-0432  
(904) 791-9042

1780 W. Beaver St.  
Jacksonville, Florida 32209



ENERGY AUDIT OF INDUSTRIAL FACILITIES  
LETTERKENNY ARMY DEPOT

Operation hours per day = 24  
Operation days per week = 7

Indoor Air Temperature (F) = 60

Hour Fractions:      1 AM - 9 AM                      1  
                             9 AM - 5 PM                      1  
                             5 PM - 1 AM                      1

Temperature Range		Hours of Occurrence			Net Hours	Delta T	Total Deg Hrs	Net Deg Hrs
		2-9	10-17	18-1				
70	74	247	237	301	785	-12	0	0
65	69	296	217	278	791	-7	0	0
60	64	269	196	236	701	-2	0	0
55	59	249	191	209	649	3	1,947	1,947
50	54	221	193	202	616	8	4,928	4,928
45	49	218	193	206	617	13	8,021	8,021
40	44	237	236	239	712	18	12,816	12,816
35	39	289	246	286	821	23	18,883	18,883
30	34	304	194	258	756	28	21,168	21,168
25	29	184	106	152	442	33	14,586	14,586
20	24	124	65	90	279	38	10,602	10,602
15	19	75	32	57	164	43	7,052	7,052
10	14	54	13	26	93	48	4,464	4,464
5	9	18	3	9	30	53	1,590	1,590
0	4	9	0	2	11	58	638	638
-5	-1	3	0	1	4	63	252	252
-10	-6	1	0	0	1	68	68	68
-15	-11	0	0	0	0	73	0	0
Totals		2798	2122	2552	7472		107015	107015

Total operation hours while heating  
corrected for working days/week = 5195 Hours/Yr

Total degree hours per year corrected for  
working days per week = 107015 Degree hours

Average outdoor temperature while heating = 39.4 F

ENERGY AUDIT OF INDUSTRIAL FACILITIES  
LETTERKENNY ARMY DEPOT

Operation hours per day = 24  
 Operation days per week = 7  
 Indoor Air Temperature (F) = 68  
 Hour Fractions:      1 AM - 9 AM      1  
                              9 AM - 5 PM      1  
                              5 PM - 1 AM      1

Temperature Range		Hours of Occurrence			Net Hours	Delta T	Total Deg Hrs	Net Deg Hrs
		2-9	10-17	18-1				
70	74	247	237	301	785	-4	0	0
65	69	296	217	278	791	1	791	791
60	64	269	196	236	701	6	4,206	4,206
55	59	249	191	209	649	11	7,139	7,139
50	54	221	193	202	616	16	9,856	9,856
45	49	218	193	206	617	21	12,957	12,957
40	44	237	236	239	712	26	18,512	18,512
35	39	289	246	286	821	31	25,451	25,451
30	34	304	194	258	756	36	27,216	27,216
25	29	184	106	152	442	41	18,122	18,122
20	24	124	65	90	279	46	12,834	12,834
15	19	75	32	57	164	51	8,364	8,364
10	14	54	13	26	93	56	5,208	5,208
5	9	18	3	9	30	61	1,830	1,830
0	4	9	0	2	11	66	726	726
-5	-1	3	0	1	4	71	284	284
-10	-6	1	0	0	1	76	76	76
-15	-11	0	0	0	0	81	0	0
Totals		2798	2122	2552	7472		153572	153572

Total operation hours while heating  
 corrected for working days/week = 6687 Hours/Yr

Total degree hours per year corrected for  
 working days per week = 153572 Degree hours

Average outdoor temperature while heating = 45.0 F

ENERGY AUDIT OF INDUSTRIAL FACILITIES  
LETTERKENNY ARMY DEPOT

Operation hours per day = 8  
 Operation days per week = 5  
 Indoor Air Temperature (F) = 68  
 Hour Fractions:      1 AM - 9 AM      0.25  
                              9 AM - 5 PM      0.75  
                              5 PM - 1 AM      0

Temperature Range		Hours of Occurrence			Net Hours	Delta T	Total Deg Hrs	Net Deg Hrs
		2-9	10-17	18-1				
70	74	247	237	301	240	-4	0	0
65	69	296	217	278	237	1	791	237
60	64	269	196	236	214	6	4,206	1,286
55	59	249	191	209	206	11	7,139	2,261
50	54	221	193	202	200	16	9,856	3,200
45	49	218	193	206	199	21	12,957	4,184
40	44	237	236	239	236	26	18,512	6,143
35	39	289	246	286	257	31	25,451	7,959
30	34	304	194	258	222	36	27,216	7,974
25	29	184	106	152	126	41	18,122	5,146
20	24	124	65	90	80	46	12,834	3,669
15	19	75	32	57	43	51	8,364	2,180
10	14	54	13	26	23	56	5,208	1,302
5	9	18	3	9	7	61	1,830	412
0	4	9	0	2	2	66	726	149
-5	-1	3	0	1	1	71	284	53
-10	-6	1	0	0	0	76	76	19
-15	-11	0	0	0	0	81	0	0
Totals		2798	2122	2552	2291		153572	46172

Total operation hours while heating  
 corrected for working days/week = 1465 Hours/Yr

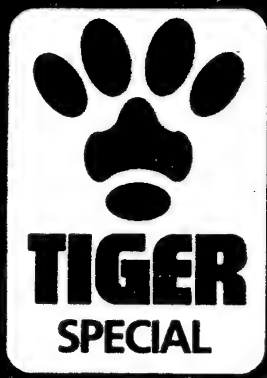
Total degree hours per year corrected for  
 working days per week = 32980 Degree hours

Average outdoor temperature while heating = 45.0 F

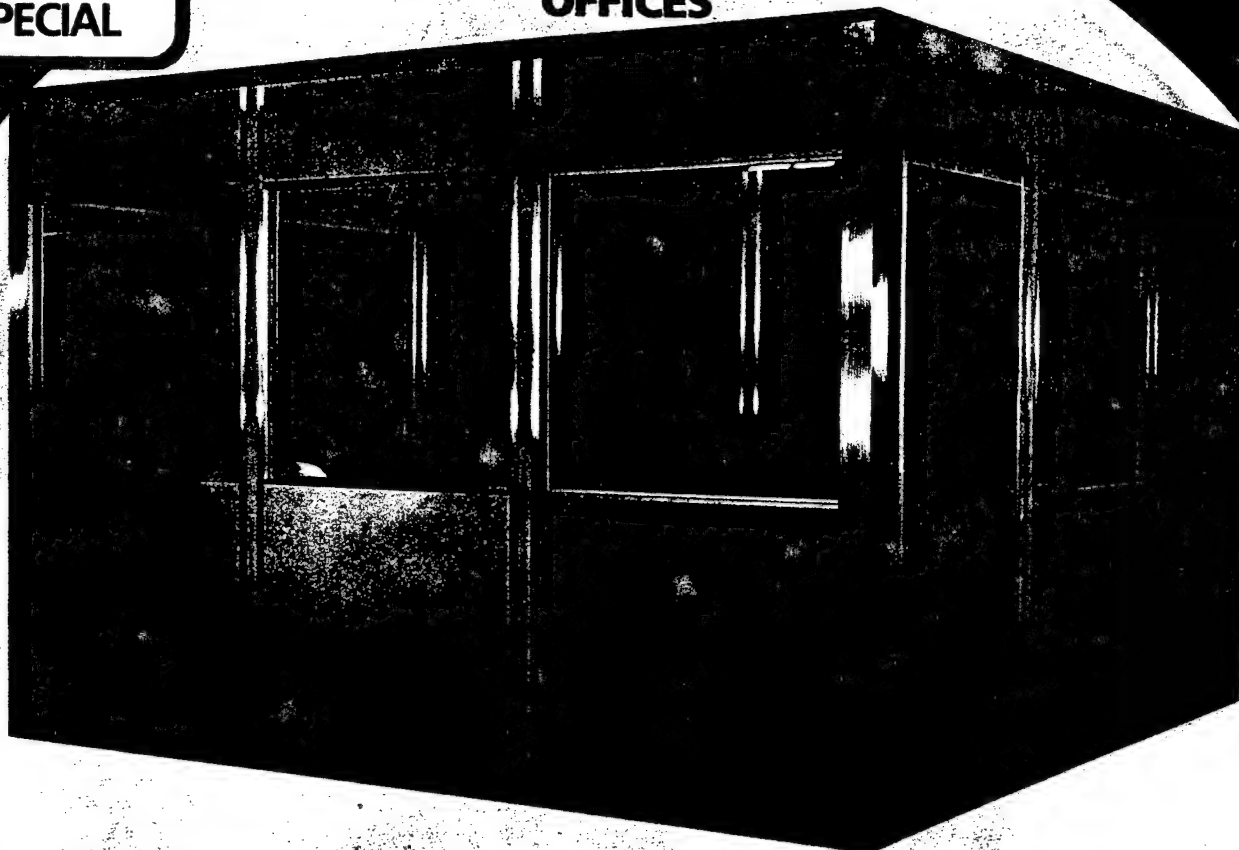
LETTERKENNY ARMY DEPOT  
FUEL CONSUMPTION REPORT  
IN GALLONS

BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
<b>** BOILER LOCATION: BUILDING 1 SERVES BUILDINGS: 1, 2 FUEL TYPE: 5</b>														
1	FY87	4545	2640	728	2810	3401	6278	10899	6000	17985	2112	3989	8052	69439
1	FY88	0	21786	9197	4575	16052	4647	10351	225	2472	0	0	0	69305
1	FY89	294	5623	9885	2697	16802	3138	10534	706	91	1321	1027	4165	56283
1	FY90	6864	10838	851	8832	15574	2377	-1	4007	0	1386	378	0	51106
<b>** BOILER LOCATION: BUILDING 2 SERVES BUILDINGS: 4, 7 FUEL TYPE: 2</b>														
2	FY87	896	732	4206	9777	9384	8246	2710	2636	3836	3636	2916	190	49165
2	FY88	8018	943	10711	12793	27167	15963	12033	8226	4936	21796	4113	1233	127932
2	FY89	2112	6053	602	2783	11941	1044	10607	1107	0	0	0	0	36249
2	FY90	5131	14811	17118	20647	4276	4882	2137	0	0	1220	4410	0	74632
<b>** BOILER LOCATION: BUILDING 3 SERVES BUILDINGS: 3, 5 FUEL TYPE: 5</b>														
3	FY87	756	6275	908	6695	15	1361	1931	2617	4275	8198	15139	5951	54121
3	FY88	3368	6455	13284	11511	3649	7043	4445	6164	392	0	0	0	56311
3	FY89	0	12449	4999	4672	17211	5886	2140	1230	0	179	228	1266	50260
3	FY90	3787	1852	2154	7188	11293	4493	-1	0	0	0	0	0	30766
<b>** BOILER LOCATION: BUILDING 8 SERVES BUILDINGS: 6, 8, 9 FUEL TYPE: 2</b>														
8	FY87	1088	7035	13054	16931	13780	9278	9475	163	0	0	123	551	71478
8	FY88	0	8435	10865	1249	24192	0	4246	77	0	3544	3534	7465	63607
8	FY89	9612	4042	2798	4808	446	4719	336	522	0	0	0	0	27283
8	FY90	3614	8846	9613	11906	7665	1679	3123	0	0	0	0	0	46446
<b>** BOILER LOCATION: BUILDING 10 SERVES BUILDINGS: 10 FUEL TYPE: 2</b>														
10	FY87	254	66	77	96	129	65	106	83	0	356	250	0	1482
10	FY88	530	1177	4509	3631	2993	3240	637	619	0	206	121	58	17721
10	FY89	103	1982	3918	4290	2413	2534	910	215	0	300	2703	500	19868
10	FY90	0	1315	4433	4942	2225	789	0	0	0	0	0	0	13704
<b>** BOILER LOCATION: BUILDING 12 SERVES BUILDINGS: 12, 13, 14 FUEL TYPE: 5</b>														
12	FY87	1794	1732	833	2938	4103	2987	961	31	62	4	92	184	15721
12	FY88	369	2414	3949	4405	3537	2370	1547	131	0	0	0	0	18722
12	FY89	800	2507	4263	2818	3824	2596	789	269	0	0	0	0	17866
12	FY90	675	3428	2929	1432	2430	3067	521	0	0	0	0	0	14482
<b>** BOILER LOCATION: BUILDING 37HP SERVES BUILDINGS: 37 FUEL TYPE: 2</b>														
37HP	FY87	3506	3583	2147	6008	4366	3582	3763	4823	1153	5113	3037	5424	46505
37HP	FY88	4633	4840	5453	6893	6583	7643	2435	5611	6266	7803	2280	6856	67296
37HP	FY89	2625	5712	6551	6816	8100	5837	5824	1110	1108	3660	6957	3379	57679
37HP	FY90	5486	9712	5367	4934	5666	9263	8553	1012	0	0	0	0	49993
<b>** BOILER LOCATION: BUILDING 37N SERVES BUILDINGS: 37 FUEL TYPE: 5</b>														
37N	FY87	101	1477	4097	4079	4300	3586	1307	155	0	0	40	40	19182
37N	FY88	731	3099	1571	2750	10474	4706	4820	156	312	624	1248	960	31451
37N	FY89	1920	1951	266	3412	4256	3531	1084	123	0	0	0	0	16543
37N	FY90	1553	5008	7038	1798	2996	5695	1079	0	0	0	0	0	25167

EN  
000



## ECONO-THREE OFFICES



National ECONO-THREE modular in-plant offices are designed for applications where cost is a major consideration.

Although low in price, these attractive enclosures offer full 3" thick, 3-ply wall panels constructed of 1/4" 4 mil vinyl-clad hardboard (each side) over a kraft honeycomb core. All panels are completely interchangeable and reuseable.

Features include pre-hung, pre-finished oak woodgrain doors, pre-painted steel-ribbed roof deck

and one-piece mill-finished extruded aluminum connection and corner posts allowing fast on-site assembly.

System incorporates all of National's quality features including exclusive "Wire-Pak" modular snap-together, six-wire wiring system. Offices are also available in vision tower and two-story versions.

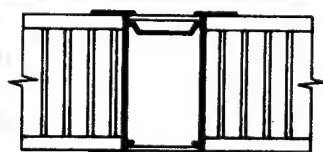
SEE PAGES 16 THROUGH 19 FOR CONSTRUCTION DETAILS.

SEE PAGE 26  
FOR ARCHITECTURAL  
SPECIFICATIONS.

### MODEL SELECTION CHART

ET64	8x8	958	ET320	16x20	2734
ET80	8x10	1012	ET336	12x28	2966
ET96	8x12	1246	ET384	12x32	3310
ET100	10x10	1260	ET388	16x24	3148
ET120	10x12	1418	ET400	20x20	3190
ET144	12x12	1590	ET448	16x28	3534
ET160	10x16	1734	ET480	20x24	3646
ET192	12x16	1934	ET512	16x32	3934
ET200	10x20	2050	ET560	20x28	4102
ET240	12x20	2278	ET640	20x32	4558
ET256	16x16	2334	ET720	20x36	5014
ET288	12x24	2622	ET800	20x40	5470

15-14



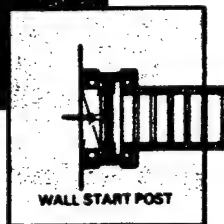
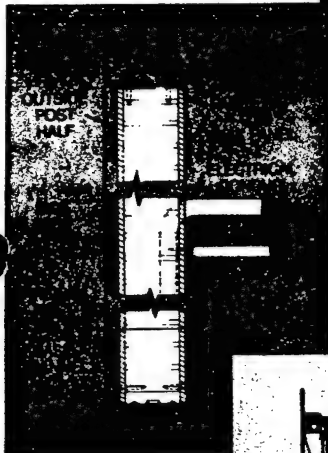


NATIONAL'S VERSATILE

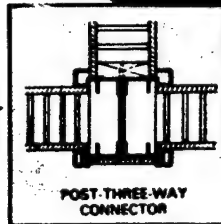
**V10™**  
POST  
SYSTEM

IS A UNIQUE STRUCTURAL  
CONCEPT THAT SERVES AS  
THE KEY ELEMENT OF  
NATIONAL'S MODULAR  
BUILDING SYSTEMS.

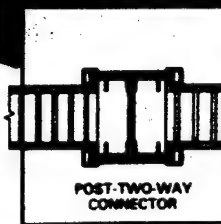
The V10 Post System was specially designed to be used in ten different ways: 1) as a wall start; 2) as a finished end; 3) as an in-line post; 4) as a 3-way post; 5) as a 4-way post; 6) as a corner post; 7) as an electrical raceway; 8) as a housing for steel inserts; 9) as a battan strip; 10) as a shelf standard when pierced.



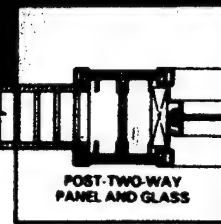
WALL START POST



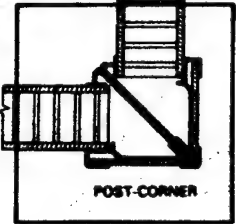
POST-THREE-WAY  
CONNECTOR



POST-TWO-WAY  
CONNECTOR



POST-TWO-WAY  
PANEL AND GLASS



POST-CORNER

1. **POSTS:** Extruded anodized aluminum with spring-held vinyl-clad feature strips to match interior/exterior panel facings (see V10™ information above).
2. **CORNER POSTS:** Massive two-piece anodized aluminum with matching vinyl-clad feature strips assure fastest possible assembly of corners.
3. **CEILING:** Attractive, white, random fissured, vinyl-faced fiberglass tile, easily cleaned to retain permanent beauty.
4. **INDIRECT LIGHTING:** Luminous fixture panels, as required, provide efficient, soft overall lighting without dark areas.
5. **CONCEALED LIGHTS:** Fluorescent, four-tube, lay-in troffer-type fixtures. Average 100 foot candles of illumination.
6. **TIE WIRES:** Fasten to roof deck with self-tapping screws and to ceiling grid main T's.
7. **ROOF DECK:** Designed to achieve optimum structural efficiency in 22 gauge steel (painted), provides clear spans up to 12 feet (20 feet with 6-inch joists).
8. **ROOF DECK END CLOSURES:** Rubber seals inserted in roof flutes contain heat and conditioned air. Insures dust-free interior.

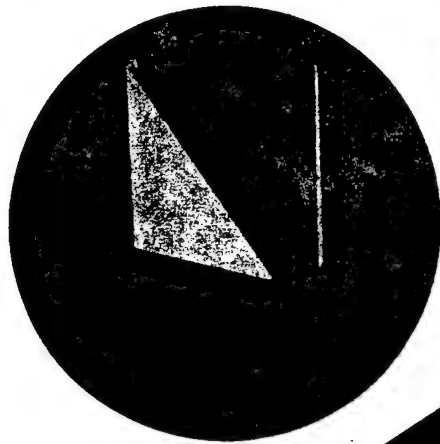
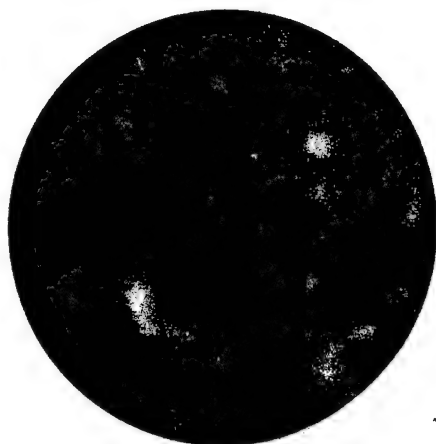
9. **CEILING GRID:** White enameled "T" support system forms a rigid frame for light fixtures and ceiling tiles.
10. **PANEL CAPS:** Anodized aluminum panel caps incorporating fascia provide finishing touch to panels as seen from exterior.
11. **WALLS:** A full 3-inch thick with honeycomb core affords structural rigidity and effective "Sound Conditioning." 3/16" tempered hardboard facings, clad in choice of "DIAMOND-COAT" vinyl colors and finishes, retain beauty with minimum maintenance.
12. **CONTINUOUS BASE CHANNEL:** Heavy anodized aluminum base channel (fastened to floor) supports and secures wall panels. Trims bottom on interior and exterior.
13. **REMOVABLE PANELS:** Special design feature of panels allows easy removal providing access for large equipment, or replacement of damaged panels, without dismantling enclosure.
14. **WINDOWS:** Optional choice of picture, sliding or pass-thru (with or without shelf). All provided with tempered safety glass.
15. **DOORS:** Attractively faced in harmonizing vinyl. Pre-hung in aluminum jamb, complete

with hardware, solid 20-inch by 30-inch door lite, and/or with 18-inch by 12-inch anodized aluminum grille are optional.

16. **WALL SWITCH:** Light switches are conveniently placed and attractive, conforming to National Code.
17. **WALL OUTLETS:** Conduit run with junction box, outlet or switch, cover plate offset fitting, conduit to reach ceiling plenum and connectors. All pre-assembled in interior posts to create vertical electric raceway.
18. **COMFORT CONTROL OPTIONS:** Include air conditioners (from 5,000 BTU to 12,000 BTU); 8-inch exhaust fan (wall-mounted), 180 CFM; heater up to 5,600 watts (Heat, off or fan) wall-mounted; anodized aluminum louver 12-inch by 18-inch.
19. **AIR CONDITIONER OUTLET:** 110 or 220 volt. (Breaker panel provided with the office kit allows separate circuit for air conditioner operation.)
20. **ENERGY-SAVER CONSTRUCTION (Optional):** Includes wall panels constructed of 3/16-inch vinyl-clad facings (each side) with an insulating polystyrene foam core (1 lb. density) and a 6-inch thick fiberglass blanket of insulation layered into the plenum area. Provides R-12 wall and R-19 roof rating.

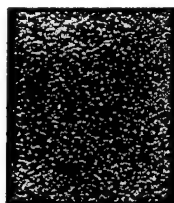
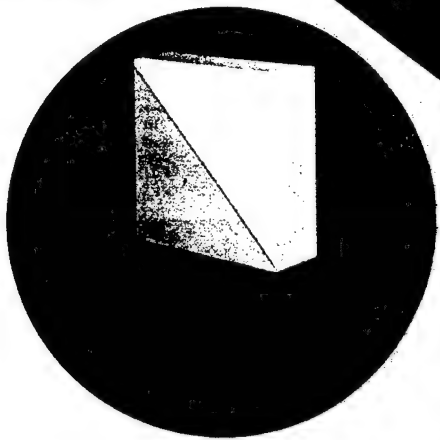
SEE PAGE 26 FOR ENGINEERING AND ARCHITECTURAL SPECIFICATIONS

# CONSTRUCTION DETAILS



## PANEL CONSTRUCTION DETAILS

NOTE:  
Other facings such as  
(but not limited to) .032-inch  
aluminum, and panel cores utilizing  
steel studs and urethane are also available.



409-SAND



NC-251-HICKORY

## STANDARD INTERIOR PANEL FINISHES –

National offices are available in the  
standard vinyl finishes as shown at left.  
These and all optional finishes (except  
801, 803 and 812 textured films)  
incorporate National's exclusive  
DIAMOND COAT™ described above.



401  
SNOW  
WHITE



NC-159  
PECAN



NC-150  
WALNUT



NC-254  
OAK



NC-156  
ROSEWOOD



NC-157  
NATURAL  
TEAK



801  
TAN  
CALCUTTA



803  
BEIGE  
CALCUTTA



812  
GREY  
CALCUTTA

## OPTIONAL INTERIOR PANEL FINISHES

National laminates their own vinyl-clad panels  
and can provide the widest selection of colors  
and woodgrains in the industry. Cork and chalk  
board facings are also available on request. Other  
finishes (not shown) can be supplied... contact  
the factory. See actual swatch samples for exact  
color and finish.



ECO # 16

Utilize Natural Gas for Boilers in Buildings 1, 2, 3,  
8, 37, 57, 320, 349, 423 and 2360.

### Assumptions:

1. LEAD will pay for all pipeline construction and the addition of dual fuel burners on boilers.
2. Peoples Natural Gas will provide natural gas for \$4.00 per MCF (\$3.88 per MBtu).
3. The boiler efficiency is 80% for both natural gas and fuel oil burners.
4. The energy saved from heating the fuel oil in the tanks is negligible.
5. The energy content of natural gas is \$1,031,000 Btu/mcf.

### Current Energy Use:

Fuel oil consumption data (from ABDS) for each building was compiled on a computer spreadsheet.

For FY90, the 10 buildings to be converted to natural gas used 89.5% of the total heating energy at LEAD.

$$\#2 \text{ Fuel oil use} = 263,269 \frac{\text{gal}}{\text{yr}} \times 0.13869 \frac{\text{MBtu}}{\text{gal}} = 36,513 \frac{\text{MBtu}}{\text{yr}}$$

$$\#5/6 \text{ fuel oil use} = 1,513,589 \frac{\text{gal}}{\text{yr}} \times 0.14969 \frac{\text{MBtu}}{\text{gal}} = 226,569 \frac{\text{MBtu}}{\text{yr}}$$



$$\text{Total} = 36,513 \frac{\text{mbtu}}{\text{yr}} \times 226,569 \frac{\text{mbtu}}{\text{yr}} = \underline{263,082 \text{ mBtu/yr}}$$

Current Energy Cost :

$$\#2 \text{ oil} : 36,513 \frac{\text{mbtu}}{\text{yr}} \times 4.76 \frac{\$}{\text{mbtu}} = \$173,802 / \text{yr}$$

$$\#5/6 \text{ oil} : 226,569 \frac{\text{mbtu}}{\text{yr}} \times 4.61 \frac{\$}{\text{mbtu}} = \$1,044,483 / \text{yr}$$

$$\text{Total cost} = \$271,292 / \text{yr} + \$1,497,621 / \text{yr} = \underline{\$1,218,285 / \text{yr}}$$

Energy Cost Utilizing Natural Gas :

$$263,082 \frac{\text{mbtu}}{\text{yr}} \times \$3.88 / \text{mbtu} = \underline{\$1,020,758 / \text{yr}}$$

Energy Cost Savings :

$$\$1,218,285 / \text{yr} - \$1,020,758 / \text{yr} = \underline{\$197,527 / \text{yr}}$$

Project Implementation Cost :

$$\text{Total project costs} = \underline{\$2,552,513}$$

See cost estimate sheet for details

Simple Payback

$$\underline{\$2,552,513} \div \underline{\$197,527 / \text{yr}} = \underline{12.9 \text{ years}}$$

Letterkenny Army Depot  
Fuel Oil Consumption Data (from ADDS)

May 7, 1991

Building Number	Convert To NG	FY 89 Use (Gal)			FY 90 Use (Gal)		
		FO#2	FO#5&6	TOTAL	FO#2	FO#5&6	TOTAL
1	Yes	0	56283	56283	0	51106	51106
2	Yes	36249	0	36249	74632	0	74632
3	Yes	0	50260	50260	0	30766	30766
8	Yes	27283	0	27283	46446	0	46446
10		19868	0	19868	13704	0	13704
12		0	17866	17866	0	14482	14482
37	Yes	57679	0	57679	49993	0	49993
37	Yes	0	16543	16543	0	25167	25167
37	Yes	0	38542	38542	0	33966	33966
57	Yes	21585	0	21585	16269	0	16269
57	Yes	0	31486	31486	0	0	0
57	Yes	0	0	0	0	41995	41995
320	Yes	76995	0	76995	63295	0	63295
349	Yes	0	843457	843457	0	1150848	1150848
349	Yes	0	0	0	0	24654	24654
423	Yes	0	84806	84806	0	103610	103610
1466		10992	0	10992	9338	0	9338
2360	Yes	14189	0	14189	12634	0	12634
2360	Yes	0	71843	71843	0	51477	51477
2384		1228	0	1228	0	0	0
2702		1898	0	1898	1601	0	1601
2755		8386	0	8386	4293	0	4293
3170		230	0	230	137	0	137
3311		3112	0	3112	1979	0	1979
3321		3626	0	3626	1185	0	1185
3387		1076	0	1076	909	0	909
3626		6984	0	6984	5778	0	5778
3700		5861	0	5861	5109	0	5109
3751		5707	0	5707	11119	0	11119
3810		12274	0	12274	13027	0	13027
3812		2309	0	2309	2116	0	2116
4341		2104	0	2104	1540	0	1540
4756		11632	0	11632	9576	0	9576
5249		9713	0	9713	6550	0	6550
5250		0	0	0	2644	0	2644
5313		3276	0	3276	2510	0	2510
5316		0	21693	21693	0	12100	12100
5647		7835	0	7835	4372	0	4372
AMMO		120638	0	120638	97110	0	97110
Total Gal/Yr		472729	1232779	1705508	457866	1540171	1998037
Total MBtu/Yr		65563	184535	250097	63501	230548	294050
Gal/Yr To NG		233980	1193220	1427200	263269	1513589	1776858
MBtu/Yr To NG		32451	178613	211064	36513	226569	263082
% FO To NG		49.5%	96.8%	84.4%	57.5%	98.3%	89.5%

<b>CONSTRUCTION COST ESTIMATE</b>				DATE PREPARED May 8, 1981		SHEET OF	
PROJECT ENERGY ENGINEERING ANALYSIS				BASIS FOR ESTIMATE <input checked="" type="checkbox"/> CODE A (No design completed) <input type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____			
LOCATION Letterkenny Army Depot							
ARCHITECT ENGINEER REYNOLDS, SMITH AND HILLS A.E.P., INC.							
DRAWING NO.		ESTIMATOR W. T. Todd		CHECKED BY			

N.G. Conversion SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
Pipeline construction with measuring, heating, odorization and regulating station.							
				PNG Estimate - 4/89			\$1,825,000
				ENR Escalation rate to 1/91			x 1.036
				Subtotal			\$1,890,700
Burner replacement for boilers in buildings 1, 2, 3, 8, 37, 57, 320, 349, 423 and 2360							
				PNG Estimate - 4/89			\$384,700
				ENR Escalation Rate to 1/91			x 1.036
				Subtotal			\$398,549
				Total Construction Costs ≈			\$2,289,249
				SEOH (5.5%)			\$125,909
				Subtotal			\$2,415,158
				Design (6%)			\$137,355
				TOTAL PROJECT COST			\$2,552,513
ENR INDEX :				4/89 =	2621		
				1/91 =	2716		

Project No. 290-0379-001

Local L.D. Placed Rec'd. 5-8-91

Bill Todd Conversed With Bill Becker → Tom Broderick  
 of Peoples Natural Gas Co. - PA Regarding Nat. Gas Service for LEAD  
412-471-5100

Bill Becker was out of the office so I spoke with Tom Broderick.

Bill B. is the most knowledgeable person about the LEAD project.

Jim Cocchia is PNG's main contact at LEAD.

There is now some capital constraints at PNG - so they will not be co-funding the pipeline construction.

PNG will provide LEAD with N.G. at \$4.00/mcf

The energy content of their N.G. is over 1,000,000 Btu/mcf

Bill Becker will call me back tomorrow.

Distribution:



SUBJECT Project D Update  
LEAD  
DESIGNER HA  
CHECKER \_\_\_\_\_

AEP NO 290-0379-001  
SHEET 1 OF \_\_\_\_\_  
DATE 4/19/91  
DATE \_\_\_\_\_

ECO # D-UP Heat Recovery - Bldgs 37 & 350

Calculations Summary

	Energy Savings (MBtu)				Capital Cost (1/91 \$)	Payback (yrs.)
	# 2	# 5	# 6	Elec		
D (1)	-	-	1166	(357)	\$ 127,403	34
D (2)	-	1083	-	(393)	159,579	56
D (3)	425	-	-	-	41,284	13
Totals	425	1083	1166	(750)	\$ 328,266	18



SUBJECT Project D Update (1)  
Heat Rec. P.B. #61, Bldg 350  
DESIGNER FFH  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 2 OF \_\_\_\_\_  
DATE 3/19/91  
DATE \_\_\_\_\_

ECO # D-UP(1) Paint Booth Exhaust Heat Recovery in Bldg 350

Energy Calculations P.B #61 Heat Recovery, Bldg 350

Energy savings were changed based on the following:

	from:	to:
Indoor Temp =	80 F	65 F
Operating Hrs =	2 shifts, 6da/wk	2 shifts, 5da/wk
Boiler Sys. Eff =	0.74	0.80
Heat Rec Eff =	0.69	0.64
A CFW =	13,700	12,141

Using the analysis found in The Paint and Drying Booths, BKA, Vol II, pp. 106-114) the following was found:

Existing booth energy use

$$\text{Make-up air heat (p. 111)} = 1363 / 0.80 = 1704 \text{ MBtu/yr} \\ \text{\#6 fuel oil}$$

$$\begin{aligned} \text{\$ Fan Energy Use} &= \\ \frac{\$1255}{0.0381 (\$/\text{kwh})} \cdot \frac{3413 \text{ Btu}}{\text{kwh}} \cdot \frac{\text{MBtu}}{10^6 \text{ Btu}} &= 112 \text{ MBtu} \\ \text{(p. 111)} & \quad \text{Electricity} \end{aligned}$$

New booth energy use

$$\text{Make up air heat (p. 110)} = 430 / 0.80 = 538 \text{ MBtu/yr} \\ \text{\#6 fuel oil}$$

$$\begin{aligned} \text{Fan energy use (p. 110)} &= \\ \frac{\$5240}{0.0381} \cdot \frac{3413}{10^6} &= 469 \text{ MBtu} \\ \text{kwh} & \quad \text{electricity} \end{aligned}$$



SUBJECT \_\_\_\_\_  
DESIGNER PA  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 3 OF \_\_\_\_\_  
DATE 2/19/91  
DATE \_\_\_\_\_

### Energy Savings

$$\#6 \text{ Fuel oil : } 1704 - 538 = \underline{1166 \text{ MBtu}}$$

$$\text{Electricity : } 112 - 469 = \underline{(357) \text{ MBtu}}$$

### Cost Estimate (p. 112)

#119,053 BKA Report July '87

Escalated to 1/91 using ENR Bldg Cost Indices =>

$$\#119,053 * 2716 \div 2538 = \underline{\underline{\$127,403}}$$

$$\text{Payback} = \frac{\$127,403}{1166 * \$6.61 - 357 * \$10.94} = \underline{\underline{34 \text{ years}}}$$



SUBJECT Project D(2) Update  
DESIGNER PFH  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 4 OF \_\_\_\_\_  
DATE 4/19/91  
DATE \_\_\_\_\_

ECO D-UP(2)

Energy Calculations P.B. #280, Bldg. 37

The original energy savings were changed to correct for the following:

	<u>from</u>		<u>to:</u>
	<u>RS&amp;H</u>	<u>BJA</u>	
Req'd CFM	16,500	18,894	18,318
Indoor temp	80°F		68°F
Boiler Sys. Eff.	0.74	0.40	0.80
Opn Hrs			
# shifts	1	varies	2
days/wk	6	varies	5
Opn. Hrs while Htg.	1300	-	3000

The energy savings were taken from the "Paint and Drying Booth" Report by BKA, Vol II pp. 22-31.

Existing energy use (p. 28)

$$\begin{aligned} \text{Make-up air (68°F, 3000 opn hrs)} \\ = 1689 \div 0.80 &= \underline{2111} \text{ MBtu/yr. #5 F.O.} \end{aligned}$$

Fan energies:

$$\frac{\$1383}{0.0381 \text{ \$/kwh}} \cdot \frac{3413 \text{ Btu/kwh}}{10^6 \text{ Btu/MBtu}} = \underline{124} \text{ MBtu/yr elec.}$$



SUBJECT Project Dk) Update

AEP NO \_\_\_\_\_

SHEET 5 OF \_\_\_\_\_

DESIGNER \_\_\_\_\_

DATE \_\_\_\_\_

CHECKER \_\_\_\_\_

DATE \_\_\_\_\_

New Energy UseMake-up air (p. 27)

$$822 \div 0.80 = 1028 \text{ MBtu/yr } \#5 \text{ F.O.}$$

Fan Energy

$$\frac{\$5773}{0.0381 \text{ \$/kwh}} \cdot \frac{3413}{106} = 517 \text{ MBtu/yr elec.}$$

Savings

$$\#5 \text{ F.O.} : 2111 - 1028 = 1083 \text{ MBtu/yr } \#5$$

$$\text{Elec.} : 124 - 517 = (393) \text{ MBtu/yr elec.}$$

Cost Estimate : p (29)

$$\$149,121 \text{ } 6/87$$

Escalate using ENR indices

$$\$149,121 \cdot \frac{2716}{2538} = \$159,579 \text{ (1/91 \$)}$$

Payback

$$\frac{159,579}{1083 \times 6.61 - 393 \times 10.94} = \underline{56 \text{ years}}$$



SUBJECT Project D Update (3)  
Heat Rec. Engine Test Cells B. 37  
DESIGNER PFH  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 6 OF \_\_\_\_\_  
DATE 3/17/91  
DATE \_\_\_\_\_

ECO # D-UP(3)  
Energy Calculations

The energy savings were changed based on the following:

	<u>From:</u>	<u>to:</u>
Boiler Sep. Eff.	0.74	0.80
Tests / yr	240	875

Current Energy use

$$\begin{array}{lcl} 37 \text{ gal / test} & = & 5.14 \text{ MBtu} \times 875 \frac{\text{tests}}{\text{yr}} = \underline{\underline{4498 \text{ MBtu}} / \text{yr}} \\ \text{Energy Recovery} & & \\ \text{Exh gas energy rec} & = & 1.07 \text{ MBtu} \\ \text{Dynamometer cooling} & = & 1.44 \text{ MBtu} \\ \text{Engine cooling water} & = & 1.80 \text{ MBtu} \end{array} \left. \begin{array}{l} \\ \\ \\ \end{array} \right\} \begin{array}{l} 4.31 \text{ MBtu/test} \\ 4.31 \times 875 = \underline{\underline{3711}} \\ \text{MBtu/yr} \end{array}$$

Energy is recovered at ~ 30 gpm of 180°F water.  
The report estimates a continuous use of steam for  
steam clean areas of 35 gpm per hose \* 3 hoses =  
105 gpm. Current operation is estimated to be  
much less than this and intermittent.



SUBJECT Project D(3) Update  
DESIGNER JH  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 7 OF \_\_\_\_\_  
DATE 3/19/91  
DATE \_\_\_\_\_

Calculate the amount of energy used at the Bldg 37 High pressure boiler. This is estimated using the fuel use of the past three years.

$$\text{Avg. fuel use} = \frac{46,505 + 67,296 + 57,679}{3} \approx 57,000 \frac{\text{gal}}{\text{yr}} \text{ \#2 F.O.}$$

$$\begin{aligned} \text{Avg. Steam use} &= 57,000 \text{ gal} \cdot \frac{138,700 \text{ Btu}}{\text{gal}} \frac{\text{MBtu}}{10^6 \text{ Btu}} \div 0.80 \text{ (boiler eff.)} \\ &= \underline{9880} \frac{\text{MBtu}}{\text{yr}} \text{ steam} \end{aligned}$$

Because the steam use is intermittent a new design is recommended with a heat exchanger in the loop. In this design heat is extracted only when "steam" cleaning is operational. Otherwise, the engine and dynamometer exit water is cooled by the existing cooling tower.

The exhaust gas heat recovery is also removed since sending this heat to the cooling tower may exceed the cooling tower capacity.

The new energy recovery values become

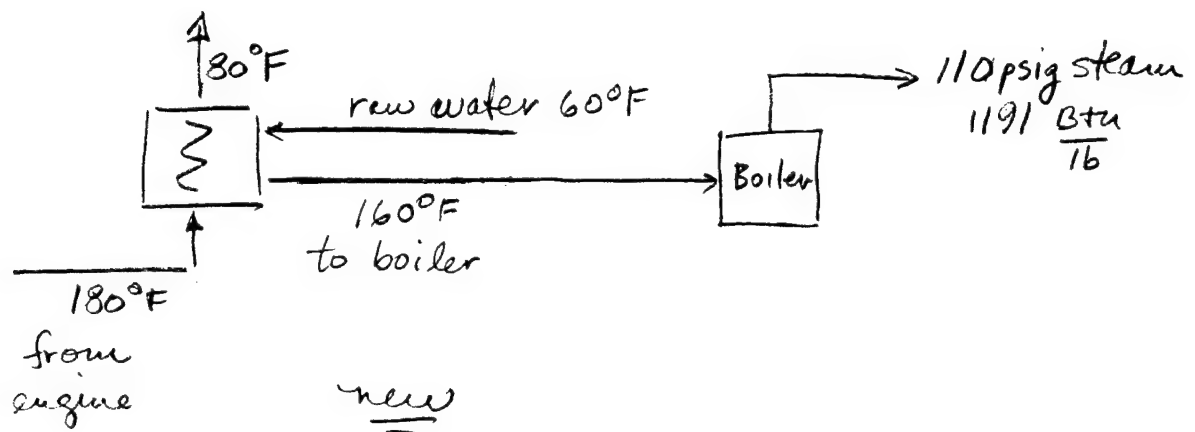
$$\begin{array}{l} \text{Dynamometer cooling} - 1.44 \text{ MBtu/test} \\ \text{Engine cooling water} - 1.80 \text{ " } \\ \hline \text{Total} \quad \quad \quad 3.24 \text{ MBtu/test} \times 875 \text{ tests} = 2835 \text{ MBtu/yr.} \end{array}$$



SUBJECT Project D(3) Update  
DESIGNER PFH  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 8 OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

However, the amount of heat that can be useful in the preheating of boiler feedwater is much less than this. The diagram below can help demonstrate this.



In the existing system the boiler heats 60°F water to 110 psig steam.

$$\Delta h = 1191 - 28 = 1163 \text{ Btu/lb}$$

In the new system the heat recovery system will heat the raw water from 60°F to 160°F ( $\Delta h = 100 \text{ Btu/lb}$ ) and the boiler will heat the 160°F water to 110# steam ( $\Delta h = 1191 - 128 = 1063$ ).

The maximum energy savings is therefore

$$100 \times \frac{1163 - 1063}{1163} = \underline{8.6\%}$$



SUBJECT Project D(3) Update  
DESIGNER PFH  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 9 OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

If one assumes that "steam" cleaning is operational half of the time during engine testing the annual savings becomes -

$$\frac{9830 \text{ MBtu}}{\text{yr}} \times 0.086 \times 0.50 = \frac{425 \text{ MBtu}}{\text{yr}} \quad \#2 \text{ F.O.}$$

### Cost Estimate

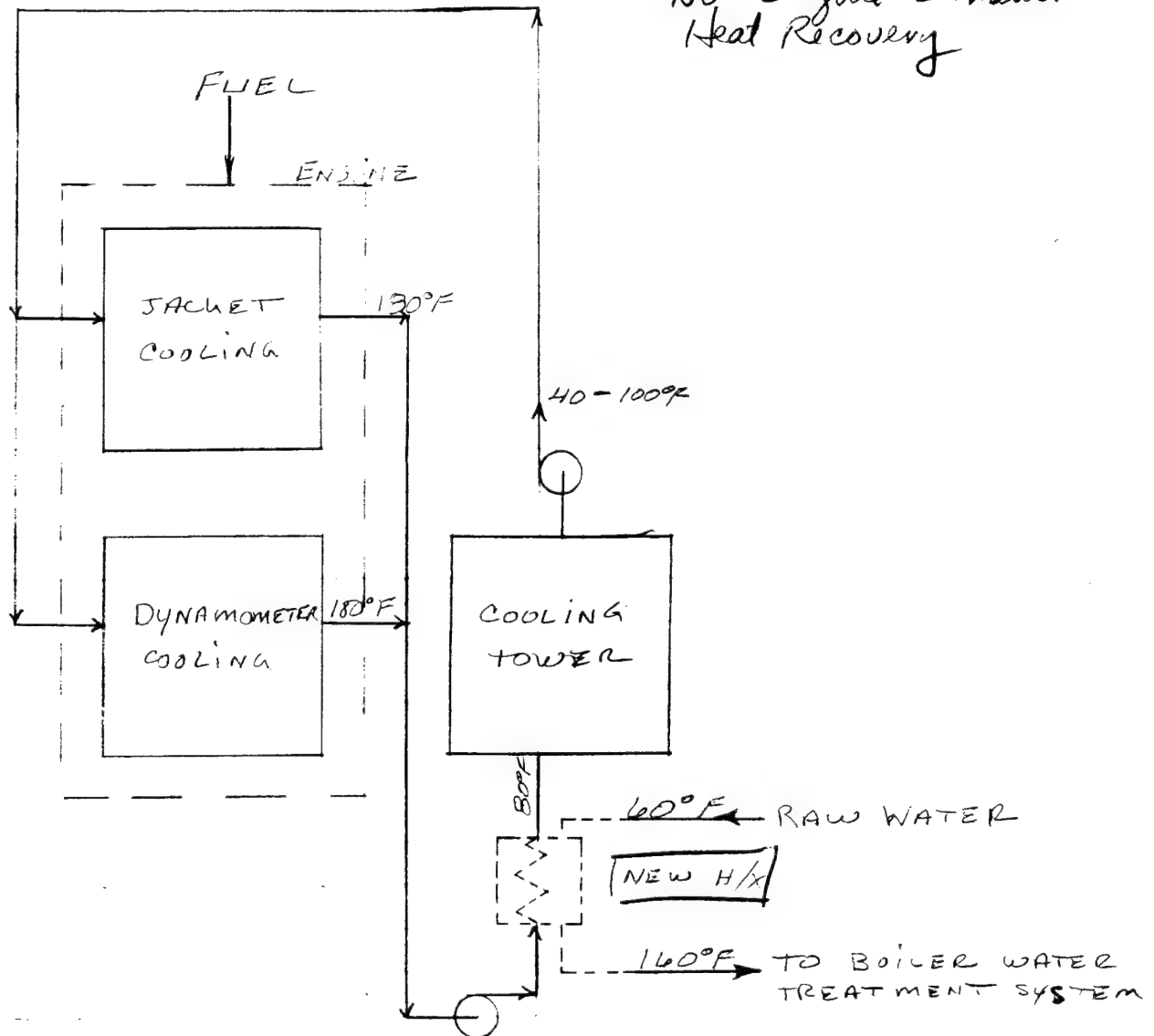
Assume that the exhaust gas heat exchanger and associated piping is approximately equivalent to the newly-required heat exchanger (between boiler feed water and ~~two~~ hot engine and dynamometer cooling water. The 1980 estimate is escalated to present.

$$\begin{array}{l} \$29,701 \times 1.39 = \$41,284 \text{ (1/91 \$)} \\ \text{(Vol 1, p. D(3) III-10)} \end{array}$$

$$\text{Payback} = \frac{\$41,284}{425 \times 7.43} \sim \underline{13.1 \text{ years}}$$

$$425 \times 7.43$$

Revised Design with New Heat Changer and  
No Engine Exhaust  
Heat Recovery



NOTE: IF CONDENSATE RETURN TO HEATING BOILERS  
IS BELOW 160°F, DUMPING IT IN FAVOR OF  
THIS WARM WATER MAY BE ADVISABLE

LETTERKENNY ARMY DEPOT  
FUEL CONSUMPTION REPORT  
IN GALLONS

BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
<b>** BOILER LOCATION: BUILDING 1      SERVES BUILDINGS: 1, 2      FUEL TYPE: 5</b>														
1	FY87	4545	2640	728	2810	3401	6278	10899	6000	17985	2112	3989	8052	69439
1	FY88	0	21786	9197	4575	16052	4647	10351	225	2472	0	0	0	69305
1	FY89	294	5623	9885	2697	16802	3138	10534	706	91	1321	1027	4165	56283
1	FY90	6864	10838	851	8832	15574	2377	-1	4007	0	1386	378	0	51106
<b>** BOILER LOCATION: BUILDING 2      SERVES BUILDINGS: 4, 7      FUEL TYPE: 2</b>														
2	FY87	896	732	4206	9777	9384	8246	2710	2636	3836	3636	2916	190	49165
2	FY88	8018	943	10711	12793	27167	15963	12033	8226	4936	21796	4113	1233	127932
2	FY89	2112	6053	602	2783	11941	1044	10607	1107	0	0	0	0	36249
2	FY90	5131	14811	17118	20647	4276	4882	2137	0	0	1220	4410	0	74632
<b>** BOILER LOCATION: BUILDING 3      SERVES BUILDINGS: 3, 5      FUEL TYPE: 5</b>														
3	FY87	756	6275	908	6695	15	1361	1931	2617	4275	8198	15139	5951	54121
3	FY88	3368	6455	13284	11511	3649	7043	4445	6164	392	0	0	0	56311
3	FY89	0	12449	4999	4672	17211	5886	2140	1230	0	179	228	1266	50260
3	FY90	3787	1852	2154	7188	11293	4493	-1	0	0	0	0	0	30766
<b>** BOILER LOCATION: BUILDING 8      SERVES BUILDINGS: 6, 8, 9      FUEL TYPE: 2</b>														
8	FY87	1088	7035	13054	16931	13780	9278	9475	163	0	0	123	551	71478
8	FY88	0	8435	10865	1249	24192	0	4246	77	0	3544	3534	7465	63607
8	FY89	9612	4042	2798	4808	446	4719	336	522	0	0	0	0	27283
8	FY90	3614	8846	9613	11906	7665	1679	3123	0	0	0	0	0	46446
<b>** BOILER LOCATION: BUILDING 10      SERVES BUILDINGS: 10      FUEL TYPE: 2</b>														
10	FY87	254	66	77	96	129	65	106	83	0	356	250	0	1482
10	FY88	530	1177	4509	3631	2993	3240	637	619	0	206	121	58	17721
10	FY89	103	1982	3918	4290	2413	2534	910	215	0	300	2703	500	19868
10	FY90	0	1315	4433	4942	2225	789	0	0	0	0	0	0	13704
<b>** BOILER LOCATION: BUILDING 12      SERVES BUILDINGS: 12, 13, 14      FUEL TYPE: 5</b>														
12	FY87	1794	1732	833	2938	4103	2987	961	31	62	4	92	184	15721
12	FY88	369	2414	3949	4405	3537	2370	1547	131	0	0	0	0	18722
12	FY89	800	2507	4263	2818	3824	2596	789	269	0	0	0	0	17866
12	FY90	675	3428	2929	1432	2430	3067	521	0	0	0	0	0	14482
<b>** BOILER LOCATION: BUILDING 37HP      SERVES BUILDINGS: 37      FUEL TYPE: 2</b>														
37HP	FY87	3506	3583	2147	6008	4366	3582	3763	4823	1153	5113	3037	5424	46505
37HP	FY88	4633	4840	5453	6893	6583	7643	2435	5611	6266	7803	2280	6856	67296
37HP	FY89	2625	5712	6551	6816	8100	5837	5824	1110	1108	3660	6957	3379	57679
37HP	FY90	5486	9712	5367	4934	5666	9263	8553	1012	0	0	0	0	49993
<b>** BOILER LOCATION: BUILDING 37N      SERVES BUILDINGS: 37      FUEL TYPE: 5</b>														
37N	FY87	101	1477	4097	4079	4300	3586	1307	155	0	0	40	40	19182
37N	FY88	731	3099	1571	2750	10474	4706	4820	156	312	624	1248	960	31451
37N	FY89	1920	1951	266	3412	4256	3531	1084	123	0	0	0	0	16543
37N	FY90	1553	5008	7038	1798	2996	5695	1079	0	0	0	0	0	25167

EN  
Poc



SUBJECT Project E-Update AEP NO 290-0379-001  
LEAD SHEET 1 OF 2  
DESIGNER PFH DATE 3/20/91  
CHECKER \_\_\_\_\_ DATE \_\_\_\_\_

ECO # E-UP Vapor Barrier for Dehumidified Warehouses  
Energy Calculations from EEAP Vol 1

Existing energy use = 317,197 kwh/yr  
Energy use with seal 155,339 kwh/yr

Savings = 161,808 kwh/yr p. E-V-29

Total energy savings for 12 uninsulated warehouses

Existing energy use 3409367 kwh  
Energy use with seal 1,670,431 "

1,739,436 " p. E-V-30B

1,739,436 kwh  $\cdot 3413 \frac{\text{Btu}}{\text{kwh}} = \underline{\underline{5937 \text{ MBtu/yr Electricity}}}$

Cost Estimate: p. E-V-36, 38, 39, 44 EEAP by RS&H

	<u>July 1980</u>	<u>July 1983</u>	<u>Jan 1991</u>
CWE	\$573,942	\$806,347	\$799,398
Design	32,864	41,224	45,774
Project Cost	<u>\$606,806</u>	<u>\$847,571</u>	<u>\$845,172</u>

In the original report July 1980 estimates were escalated to July 1983 at 12% per year, and those values are shown here. July 1980 estimates are escalated to January 1991 using ENR Building cost indices.

ENR Indices July 1980 = 1950, Jan 1991 = 2716



SUBJECT Project E - Update

AEP NO. \_\_\_\_\_

SHEET 1 OF 2

DESIGNER \_\_\_\_\_

DATE \_\_\_\_\_

CHECKER \_\_\_\_\_

DATE \_\_\_\_\_

Additional costs -

Sealant life expectancy is about 10-15 years  
Should be applied again with one coat

Cost is  $\frac{1}{2}$  the construction cost

$$= 758,002 / 2 = \underline{\$379,001}$$

10/09/91

ECO Construction Cost Estimate  
Calculations

ECO Name: Vapro Barrier for Dehumidified Warehouses

ECO #: E-UP

1991 ECO "bare" costs (from cost estimate sheet)		
Material		\$129,051
Labor		\$334,920
	Subtotal bare costs	\$463,971
FICA Insurance (20% of Labor)		\$66,984
Sales Tax (6.5% of Material)		\$8,388
	Subtotal	\$539,343
Overhead (15%)		\$80,902
	Subtotal	\$620,245
Profit (10%)		\$62,025
	Subtotal	\$682,270
Bond (1%)		\$6,823
	Subtotal	\$689,093
Contingency (10%)		\$68,909
		+-----+
Subtotal (Construction Cost Input For LCCID *)		\$758,002
		+-----+
SIOH (5.5% of Construction Cost)		\$41,690
	Subtotal	\$799,692
Design (6% of Construction Cost)		\$45,480
		-----
Total Project Cost		\$845,172

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

E-UP-3

Project No. 290-0379-001Local \_\_\_\_\_ L.D. ☒ Placed ☒ Rec'd. \_\_\_\_\_ Date 10/4/91\_\_\_\_\_ P. Hutchins \_\_\_\_\_ Conversed With Bob CartyOf IPA Systems \_\_\_\_\_ Regarding DRYCON Sealant

- BC will send literature

- Can get prices from

Glen Rexrod

Triboro Concrete

Dallastown, PA (near Harrisburg)

(717) 246-3095

- Prices received from Ed McCarthy in Philadelphia

~ 1.75/SF for contracted price

~ 0.45/SF for materials

these values work very close to original estimate  
evaluated to date using ENR indices

Distribution:

E-WP-4

Project No. 290-0379-001

Local \_\_\_\_\_ L.D. ✓ Placed MX Rec'd. ✓ Date 10/1/91

\_\_\_\_\_ P. Hutchins \_\_\_\_\_ Conversed With Wen Richardson

Of LEAD \_\_\_\_\_ Regarding Dehumidified Warehouses

- MR verified that the following warehouses are dehumidified ~~and~~, not heated, and do not have interior wall insulation

#s 11, 18, 31, 32, 34, 41, 44, 52, 53, 55, 56 (47?)

Distribution:

SUBJECT LEAD ECO#G-UPAEP NO 290-0379-001DESIGNER G. Fallon

SHEET \_\_\_\_\_ OF \_\_\_\_\_

CHECKER \_\_\_\_\_

DATE \_\_\_\_\_

DATE \_\_\_\_\_

ECO #G-UP

UPDATE BLDG 350 N DIP TANK EXHAUST HEAT RECOVERY

ASSUMPTION CHANGES

TANK NO.	FLOW (CFM)		TEMPERATURE		OPERATING HRS.		Boiler Eff	
	1980 <sup>⑤</sup>	1991 <sup>④</sup>	1980 <sup>③</sup>	1991 <sup>⑥</sup>	1980 <sup>⑤</sup>	1991 <sup>③</sup>	1980 <sup>⑤</sup>	1991
2512 <sup>①</sup>	14000	—	83	—	2270	—	.74	—
2514	15660	9360	83	68	2270	8760	.74	.8
2516	25560	6450	83	68	2270	8760	.74	.8
2518	14,000	9360	83	68	2270	8760	.74	.8
2520	12,186	12600	83	68	2270	8760	.74	.8
NG 274 <sup>①</sup>	—	9360	—	68	—	8760	—	.8
TOTALS	81,406	47,160						

NOTE: ① TANK NO. 2512 HAS BEEN CONVERTED TO A NON-VENTED APPLICATION, BUT TANK NO NG 274 HAS BEEN ADDED. SO THE NUMBER OF TANKS REMAINS THE SAME.

② DESIGN TEMPERATURE IS USED PER LEAD REQUEST WHILE HEATING.

③ OPERATING HOURS, CHANGE. OSHA REGS REQUIRE CONTINUOUS OPERATION WITH TANKS UN-COVERED

④ VOLUMES ARE DESIGN VALUES. (LEAD DIP TANK SURVEY)

⑤ LEAD EEP, RSH, 1980

CURRENT HEAT LOSS (TANK 2514)

$$q = \frac{9360 \text{ CFM} \times 165858 \text{ BTU/yr} \cdot \text{CFM}^*}{0.8 \times 10^6 \text{ BTU/MBTU}} = 1940 \text{ MBTU/yr}$$

\* FROM BIN TEMP METHOD, ENCLOSED.

G-UP-1

SUBJECT LEAD ECO# G-UP

AEP NO. \_\_\_\_\_

SHEET \_\_\_\_\_ OF \_\_\_\_\_

DESIGNER \_\_\_\_\_

DATE \_\_\_\_\_

CHECKER \_\_\_\_\_

DATE \_\_\_\_\_

ENERGY SAVINGS

HEAT EXCHANGER REMAINS 66% EFFICIENT

$$1940 \text{ MBTU/yr} \times 0.66 = \boxed{1280 \text{ MBTU/yr}}$$

COST SAVINGS

$$1280 \text{ MBTU/yr} \times \$6.6/\text{MBTU} = \$8472/\text{yr. (FY91\$)}$$
$$\quad \quad \quad \$5907/\text{yr. (FY92\$)}$$

ADDITIONAL FAN ENERGY

FAN OPERATING COST FROM EEAR COMPUTER PRINTOUT.

SUPPLY FAN (154.02/yr) #2514 EEAR Vol 2 p. G-V-18FAN ENERGY CONSUMPTION IS DIRECTLY PROPORTIONAL  
TO FAN FLOW

$$\frac{\$154.02/\text{yr}}{\$0.03/\text{kwh}} \times \frac{3413 \text{ BTU/kwh}}{10^6 \text{ BTU/MBTU}} \times \frac{9360 \text{ CFM}}{15660 \text{ CFM}} = 10.47 \text{ MBTU/yr}$$

EXHAUST FAN (\$157.59/yr)

$$\frac{\$157.59/\text{yr}}{\$0.03/\text{kwh}} \times \frac{3413 \text{ BTU/kwh}}{10^6 \text{ BTU/MBTU}} \times \frac{9360 \text{ CFM}}{15660 \text{ CFM}} = 10.71 \text{ MBTU/yr}$$

TOTAL FANS (ADDITIONAL CONSUMPTION)

$$10.47 \text{ MBTU/yr} + 10.71 \text{ MBTU/yr} = \boxed{21.18 \text{ MBTU/yr}}$$

THE ABOVE METHOD WAS APPLIED TO THE OTHER TANKS  
USING SPREAD SHEET SOFTWARE. THE RESULTS  
ARE ON THE SUMMARY PAGE.

LETTERKENNY ARMY DEPOT  
 ECO # G-UP  
 BUILDING 350 N DIP TANK  
 EXHAUST HEAT RECOVERY  
 SUMMARY

Tank Number	Flow (cfm)	Energy Savings		(FY91 \$)		Const. Cost (1991 \$)	Payback (years)
		No 6 F.O. (MBTU/yr)	ELEC (MBTU/yr)	Cost Savings (\$/yr)			
2514	9360	1281	-21	8234		47589	5.8
2516	6480	887	-15	5700		47589	8.3
2518	9360	1281	-21	8234		47589	5.8
2520	12600	1724	-29	11024		47589	4.3
NG 274	9360	1281	-21	8234		47589	5.8
TOTAL	47160	6453	-107	41487		237945	5.7
				\$28,578 (FY92 \$)			8.3

# LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 24

Room or Supply Air Conditions - Winter 68  
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 1  
9 AM - 5 PM 1  
5 PM - 1 AM 1

Operation Days Per Week 5

	Temp. Range	Hours of Occurrence			Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
		2-9	10-17	18-1						
70	74	247	237	301	785	-4	1.08	1	0	0
65	69	296	217	278	791	1	1.08	1	1	554
60	64	269	196	236	701	6	1.08	1	6	4,542
55	59	249	191	209	649	11	1.08	1	12	7,710
50	54	221	193	202	616	16	1.08	1	17	10,644
45	49	218	193	206	617	21	1.08	1	23	13,994
40	44	237	236	239	712	26	1.08	1	28	19,993
35	39	289	246	286	821	31	1.08	1	33	27,487
30	34	304	194	258	756	36	1.08	1	39	29,393
25	29	184	106	152	442	41	1.08	1	44	19,572
20	24	124	65	90	279	46	1.08	1	50	13,861
15	19	75	32	57	164	51	1.08	1	55	9,033
10	14	54	13	26	93	56	1.08	1	60	5,625
5	9	18	3	9	30	61	1.08	1	66	1,976
0	4	9	0	2	11	66	1.08	1	71	784
-5	-1	3	0	1	4	71	1.08	1	77	307
-10	-6	1	0	0	1	76	1.08	1	82	82
-15	-11	0	0	0	0	81	1.08	1	87	0
-----										
Totals		2798	2122	2552	7472					165,858

Total Operation Hours While Heating  
(and corrected for working days/week) 4776 118,470

Avg outdoor temp while heating (F) 45.0

G-UP-4



05/17/91

ECO Update Construction Cost Estimate  
Calculations

ECO Name: EXHAUST HEAT RECOVERY, BUILDING 350 N DIP TANKS

ECO #: G-UP

Year of original cost estimate: 1980

ECO "bare" costs (from original cost estimate)

Material	\$79,415
Labor	\$20,368

Escalation to 1991

Escalation rates from Engineering News Record:

From 6/80 to 1/91 = 1.393

From 6/81 to 1/91 = 1.290

Material	= \$79,415 x 1.393	= \$110,611
Labor	= \$20,368 x 1.393	= \$28,369
Total	= \$110,611 + \$28,369	= \$138,980

Bare 1991 Escalated Costs	\$138,980
FICA Insurance (20% of Labor)	\$5,674
Sales Tax (6.5% of Material)	\$7,190

Subtotal	\$151,844
Overhead (15%)	\$22,777

Subtotal	\$174,621
Profit (10%)	\$17,462

Subtotal	\$192,083
Bond (1%)	\$1,921

Subtotal	\$194,004
Contingency (10%)	\$19,400

Subtotal (Construction Cost Input For LCCID *)	\$213,404
--	-----------

SIOH (5.5% of Construction Cost)	\$11,737
----------------------------------	----------

Subtotal	\$225,141
Design (6% of Construction Cost)	\$12,804

Total Project Cost	\$237,945
--------------------	-----------

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

G-UP-5

SUBJECT ECO # G-UPAEP NO 290-0379-001DESIGNER P. Hutchins

SHEET \_\_\_\_\_ OF \_\_\_\_\_

CHECKER \_\_\_\_\_

DATE 10/4/91

DATE \_\_\_\_\_

- If ECO#3, Dip Tank Covers with Variable Speed Drives on Exhaust Fans, is implemented, savings for this ECO will be significantly changed. ECO#3 basically reduces the full load operating hours from 8760 hrs/yr to 16 hrs/dn, 5dn/wk, 52 wk/yr.

- Calculate the energy savings change

With ECO#3 implemented, the exhaust fans will operate full load for 16 hrs/dn, 5dn/wk and a 1% load the remainder.

The new HLF (heat loss factor, heating req'd per cfm of OSA) is calculated from attached spreadsheets.

<u>Opn hrs.</u>	<u>HLF (kBtu/cfm/yr)</u>
24 hr/dn, 7dn/wk	165.9
16 hr/dn, 5dn/wk (1 <sup>st</sup> & 2 <sup>nd</sup> shifts)	73.3
24 h/dn, 2dn/wk	47.4
8 hr/dn, 5dn/wk (3 <sup>rd</sup> shift)	45.2

$$\text{New HLF} = \underbrace{(1.0)(73.3)}_{1^{\text{st}} \& 2^{\text{nd}} \text{ shifts}} + \underbrace{(47.4) \times (0.01)}_{\text{weekends}} + \underbrace{(45.2)(0.01)}_{3^{\text{rd}} \text{ shift}} = \underline{74.2}$$

- New savings is the ratio of HLF's =  $\text{OLD SAVINGS} \times \frac{\text{HLF}_{\text{New}}}{\text{HLF}_{\text{Old}}}$

$$= 6453 \frac{\text{MBtu}}{\text{yr}} \times \frac{74.2}{165.9} = 2886 \frac{\text{MBtu}}{\text{yr}}$$

# ECO# G-UP WITH ECO#3 IMPLEMENTED

## LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: ECOGUPA

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LCCID 1.062

INSTALLATION & LOCATION: LETTERKENNY A.REGION NOS. 3 CENSUS: 1

PROJECT NO. & TITLE: ECO G-UP-A DIP TANK EXHAUST HEAT RECOVERY

FISCAL YEAR 1991 DISCRETE PORTION NAME: TOTAL PROJECT

ANALYSIS DATE: 10-04-91 ECONOMIC LIFE 25 YEARS PREPARED BY: P. HUTCHINS

### 1. INVESTMENT

A. CONSTRUCTION COST	\$	213404.
B. SIOH	\$	11738.
C. DESIGN COST	\$	12805.
D. SALVAGE VALUE COST	-\$	0.
E. TOTAL INVESTMENT (1A + 1B + 1C - 1D)	\$	237947.

### 2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 10.94	-107.	\$ -1171.	15.11	-17687.
B. DIST	\$ 4.76	0.	\$ 0.	21.31	0.
C. RESID	\$ 4.61	2886.	\$ 13304.	25.22	335538.
D. NAT G	\$ .00	0.	\$ 0.	20.70	0.
E. COAL	\$ .00	0.	\$ 0.	15.93	0.
F. TOTAL		2779.	\$ 12134.		\$ 317851.

### 3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	14.53	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	104891.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F) _____		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YRS ECONOMIC LIFE))\$ 12134.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) \$ 317851.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.34  
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 19.61

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 16 (ECO #3 implemented)  
(1st & 2nd shift)

Room or Supply Air Conditions - Winter 68  
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 0.25  
9 AM - 5 PM 1  
5 PM - 1 AM 0.75

Operation Days Per Week 5

Temp. Range	Hours of Occurrence			Total Hours	Delta T	Const.	CFM	Btu /Hr	Total Btu
70 74	247	237	301	525	-4	1.08	1	0	0
65 69	236	217	278	500	1	1.08	1	1	539
60 64	269	196	236	440	6	1.08	1	6	2,853
55 59	249	191	209	410	11	1.08	1	12	4,871
50 54	221	193	202	400	16	1.08	1	17	6,908
45 49	218	193	206	402	21	1.08	1	23	9,117
40 44	237	236	239	475	26	1.08	1	28	13,324
35 39	289	246	286	533	31	1.08	1	33	17,836
30 34	304	194	258	464	36	1.08	1	39	18,021
25 29	184	106	152	266	41	1.08	1	44	11,778
20 24	124	65	90	164	46	1.08	1	50	8,123
15 19	75	32	57	94	51	1.08	1	55	5,150
10 14	54	13	26	46	56	1.08	1	60	2,782
5 9	18	3	9	14	61	1.08	1	66	939
0 4	9	0	2	4	66	1.08	1	71	267
-5 -1	3	0	1	2	71	1.08	1	77	115
-10 -6	1	0	0	0	76	1.08	1	82	21
-15 -11	0	0	0	0	81	1.08	1	87	0
Totals	2798	2122	2552	4736					102,644

Net heat loss corrected for working days/week (Btu/cfm\*yr) = 73,317

Total Operation Hours While Heating  
(and corrected for working days/week) = 3008

Average outdoor temperature while heating = 45.0 F

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 24 (ECO #3 implemented)  
- weekend -

Room or Supply Air Conditions - Winter 68  
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 1  
9 AM - 5 PM 1  
5 PM - 1 AM 1

Operation Days Per Week 2

Temp. Range	Hours of Occurrence				Total Hours	Delta T	Const.	CFM	Btu /Hr	Total Btu
70	74	247	237	301	785	-4	1.08	1	0	0
65	69	296	217	278	791	1	1.08	1	1	854
60	64	269	196	236	701	6	1.08	1	6	4,542
55	59	249	191	209	649	11	1.08	1	12	7,710
50	54	221	193	202	616	16	1.08	1	17	10,644
45	49	218	193	206	617	21	1.08	1	23	13,994
40	44	237	236	239	712	26	1.08	1	28	19,993
35	39	289	246	286	821	31	1.08	1	33	27,487
30	34	304	194	258	756	36	1.08	1	39	29,393
25	29	184	106	152	442	41	1.08	1	44	19,572
20	24	124	65	90	279	46	1.08	1	50	13,861
15	19	75	32	57	164	51	1.08	1	55	9,033
10	14	54	13	26	93	56	1.08	1	60	5,625
5	9	18	3	9	30	61	1.08	1	66	1,976
0	4	9	0	2	11	66	1.08	1	71	784
-5	-1	3	0	1	4	71	1.08	1	77	307
-10	-6	1	0	0	1	76	1.08	1	82	82
-15	-11	0	0	0	0	81	1.08	1	87	0
-----										=====
Totals		2798	2122	2552	7472					165,858

Net heat loss corrected for working days/week (Btu/cfm\*yr) = 47,388

Total Operation Hours While Heating  
(and corrected for working days/week) = 1911

Average outdoor temperature while heating = 45.0 F

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 8 (THIRD SHIFT) ECO#3 implemented

Room or Supply Air Conditions - Winter 68  
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 0.75  
9 AM - 5 PM 0  
5 PM - 1 AM 0.25

Operation Days Per Week 5

Temp. Range	Hours of Occurrence			Total Hours	Delta T	Const.	CFM	Btu /Hr	Total Btu
	2-9	10-17	18-1						
70 74	247	237	301	261	-4	1.08	1	0	0
65 69	296	217	278	292	1	1.08	1	1	315
60 64	269	196	236	261	6	1.08	1	6	1,690
55 59	249	191	209	239	11	1.08	1	12	2,839
50 54	221	193	202	216	16	1.08	1	17	3,737
45 49	218	193	206	215	21	1.08	1	23	4,876
40 44	237	236	239	238	26	1.08	1	28	6,669
35 39	289	246	286	288	31	1.08	1	33	9,651
30 34	304	194	258	293	36	1.08	1	39	11,372
25 29	184	106	152	176	41	1.08	1	44	7,793
20 24	124	65	90	116	46	1.08	1	50	5,738
15 19	75	32	57	71	51	1.08	1	55	3,883
10 14	54	13	26	47	56	1.08	1	60	2,843
5 9	18	3	9	16	61	1.08	1	66	1,038
0 4	9	0	2	7	66	1.08	1	71	517
-5 -1	3	0	1	3	71	1.08	1	77	192
-10 -6	1	0	0	1	76	1.08	1	82	62
-15 -11	0	0	0	0	81	1.08	1	87	0
-----									
Totals	2798	2122	2552	2737					63,213

Net heat loss corrected for working days/week (Btu/cfm\*yr) = 45,152

Total Operation Hours While Heating  
(and corrected for working days/week) = 1769

Average outdoor temperature while heating = 45.0 F



SUBJECT Project H - Update  
LEAD  
DESIGNER JA  
CHECKER \_\_\_\_\_

AEP NO 290-0379-001  
SHEET 1 OF \_\_\_\_\_  
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DATE \_\_\_\_\_

ECO # H - UP Baghouse Insulation and Air Return (#350 & #37)

Summary Baghouse Insulation

<u>Cfm</u>	<u>Bldg #</u>	<u>Baghouse #</u>	<u>Savings #5/6 F.O (MPSu/yr)</u>	<u>(1/91) \$ Savings</u>	<u>Project Cost (6/80 \$)</u>	<u>project Cost (1/91 \$)</u>	<u>(1/91) PAYBACK (yrs)</u>
44,000	350	49	511 (#6)	\$3378	\$21,636	\$30,074	8.9
4460	350	50 (2)	981 (#6)	6484	37,556	52,203	8.1
4800	350	2544	351 (#6)	2320	16,663	23,162	10.0
6000	1 *	120	298 (#5)	1970	11,038	15,343	7.8
2115	1 *	1586	33 (#5)	549	4563	6343	11.6
12,000	37 *	1294	764 (#5)	5050	9409	13,079	2.6
			2988 (#6) 1843	\$19,751	\$100,864	\$140,204	7.1
			1145 (#5)				

\* Includes insulation and return of exhausted air

SUBJECT Project H - Update

AEP NO \_\_\_\_\_

DESIGNER PFHSHEET 2 OF \_\_\_\_\_

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Eco # H-UP Baghouse Insulation and Air Return (#350 & #37)Energy Calculations - Bldg 350 - Baghouse 49

Energy savings calculations were adjusted due to the following:

	from	to
Indoor temp	55°F ( $\Delta T = 12.5$ )	68°F ( $\Delta T = 23$ )
Radiation losses	calculated	0
Opn Hrs while lty.	2270	3000
Avg. Amb. temp while lty (F)	42.5	45
Boiler Sys. Eff	0.74	0.80

	Heat Loss w/o insul.		
	cond	rad.	total
Inlet duct (p. H-V-3)	31,160 ( $\frac{23.0}{12.5}$ )	11,209 (0)	= 57,334
Baghouse (p. H-V-5)	26,266 ( $\frac{23.0}{12.5}$ )	19,355 (0)	= 48,329
Outlet duct	20,487 ( $\frac{23.0}{11.5}$ )	7353 (0)	= 42,836

Total 148,499

Heat loss with insulation

$$= 1290 \left( \frac{23.0}{12.5} \right) + 3178 \left( \frac{23.0}{12.5} \right) + 1963 \left( \frac{23.0}{11.5} \right) = 12,147$$

136,352 Btu/yr

Fuel savings =  $\frac{\text{Heat loss} \times \text{Hrs opn}}{\text{Boiler sys eff} \times 10^6}$

=  $\frac{136,352 \times 3000}{0.80 \times 10^6} = 511 \text{ MBtu/yr}$

#6 fuel oil

Capital Cost =  $\text{CWE} + \text{Design (6\%)} = \$20,411 + 1225 = \$21,636$

(p. H-V-10) Esc to 1/91 =>  $21,636 \times 1.39 = \$30,074$





SUBJECT Project H - Update  
DESIGNER PFH  
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Bldg 350 - Baghouse 50 (three baghouses)

Energy savings calculations were adjusted for the following:

	<u>from</u>	<u>to</u>
Indoor temp.	55° (ΔT=12.5)	68°F (ΔT=23)
Radiation losses	Calculated	0
Open hrs. while htg.	2270	3000
Avg. outdoor temp. while htg.	42.5	45.0
Boiler Sys. Eff	0.74	0.80
Heat Loss (Btu/hr) w/o insulation		

	<u>Cond.</u>	<u>Rad.</u>	<u>total</u>
Inlet Duct (p. H-II-3)	85,518 ( $\frac{23.0}{12.5}$ )	+ 29,506 (0)	= 157,353
Baghouse (1) (p. H-III-4)	21,542 ( $\frac{23.0}{11.35}$ )	+ 36,986 (0)	= 43,653
Small Baghouse (2) (p. H-VI-6)	7811 × 2 ( $\frac{23.0}{10.3}$ )	+ 5718 × 2 (0)	= 34,884
Outlet Duct (p. H-VI-6)	18,980 ( $\frac{23.0}{9.9}$ )	+ 6778 (0)	= <u>44,095</u>

TOTAL Heat loss 279,985

Heat loss with insul. = 9932 ( $\frac{23.0}{12.5}$ ) 18,275

Heat loss reduction 261,710

Fuel Savings =  $(261,710 \frac{\text{Btu}}{\text{hr}}) (3000 \text{ hrs}) \div 0.80 \div 10^6 = \underline{981} \frac{\text{MMBtu}}{\text{yr}} \#6 \text{ P.O.}$

Cost = 35,430 + 2126 (design) = \$37,556 (6/80¢)  
p. H-VI-9 Esc to 1/91 ⇒ 37,556 × 1.39 = \$52,203  
H-UP-3



SUBJECT Eco# H-UP  
DESIGNER PFH  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
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Building 350 - Baghouse 2544

Energy calculations were adjusted for the following:

	<u>from</u>	<u>To</u>
Indoor temp.	55°F (ΔT=12.5)	68°F (ΔT=23.0)
Radiation losses	Calculated	0
Boiler System Eff.	0.74	0.80
Heat Loss w/o insulation (Btu/hr)		

	<u>cond.</u>	<u>rad.</u>	<u>total</u>
Inlet duct p. H-VII-1	$17,915 \left( \frac{23.0}{12.5} \right)$	$+ 6449 (0)$	$= 32,964$
Baghouse p. H-VII-2	$24,247 \left( \frac{23.0}{12} \right)$	$+ 17,841 (0)$	$= 46,473$
Exh. duct p. H-VII-4	$11,185 \left( \frac{23.0}{11} \right)$	$+ 4009 (0)$	$= 23,387$

Total heat loss w/o insul. 102,824

total w/ insul. =  $4980 \left( \frac{23.0}{12.5} \right) =$   
p. H-VII-5 - 9163

Total heat loss reduction 93,661

Fuel savings =  $(93,661)(3000) \div 0.80 \div 10^6 = \underline{\underline{351 \text{ MBtu} \#6 \text{ F.O.}}}$   
yr

Cost =  $15,720 + 943(\text{design}) = \underline{\underline{\$16,663 (6/80\#)}}$

p. H-VII-6

Esc. to 1/91  $\Rightarrow 16,663 \times 1.39 = \underline{\underline{\$23,162}}$



SUBJECT ECO # H-UP  
DESIGNER PFH  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 5 OF \_\_\_\_\_  
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DATE \_\_\_\_\_

Bldg 1 - Baskhouses (2) -

Return exhausted air Baskhouse #120

Energy calculations were adjusted for boiler system  
eff of 0.74 to 0.80.

$$\text{Make-up air fuel} = 328 \left( \frac{0.74}{0.80} \right) = 303 \text{ MBtu/yr}$$

p. H-VIII-2

$$\text{Heat Losses fuel} = 5.7 \text{ MBtu} \left( \frac{0.74}{0.80} \right) = 5 \text{ MBtu/yr}$$

p. H-VIII-4

Net fuel

$$\underline{298 \text{ MBtu/yr}}$$

Costs

$$\text{Project Cost} = 10,413 + 625 = \underline{\$11,038 (6/80 \$)}$$

p. H-VIII-5

$$\text{Esc. to 1/91} \Rightarrow 11,038 \times 1.39 = \underline{\$15,343}$$



SUBJECT ECO # H-UP  
DESIGNER PFH  
CHECKER \_\_\_\_\_

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DATE \_\_\_\_\_

Bldg 1 - Baghouse #1586 (small)

Return exhaust and insulate

Adjust effs for boiler system eff = 0.80

$$\text{Fuel saved} = \frac{59.2 \text{ MBtu} \times 0.74}{0.80} = \underline{53 \text{ MBtu/yr.}}$$

p. H-IX-3

$$\text{Cost} = 4305 + 258 (\text{design}) = \underline{\$4563} \quad (6/80 \$)$$

p. H-IX-4

$$\text{Esc to 1/91} \Rightarrow 4563 \times 1.39 = \underline{\underline{\$6343}}$$



SUBJECT ECO # H-UP  
\_\_\_\_\_  
DESIGNER PEH  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 7 OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

Bldg 37- Baghouse #1294 - Return Exhaust & Insulate

Energy calculations are changed for:

	from	to
boil up off	0.74	0.80
opn hrs.	1300	4160/2
(heating season)		

$$\text{Fuel saved} = \frac{516 \text{ MBtu}}{\text{yr}} \left( \frac{0.74}{0.80} \right) \left( \frac{4160/2}{1300} \right) = \frac{764 \text{ MBtu}}{\text{yr}}$$

#5 F.O.

$$\text{Cost} = \$8876 + 533 = \underline{\$9409} \quad (6/80\$)$$

(p. H-8-4)

$$\text{Esc to 1/91} \Rightarrow 9409 \times 1.39 = \underline{\$13,079}$$



SUBJECT Project I - Update  
Paint Booth Exh Heat Recovery  
DESIGNER BA  
CHECKER \_\_\_\_\_

AEP NO 290-0379-001  
SHEET 1 OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

ECO # I-UP <sup>Large</sup> Paint Booth Exhaust Heat Recovery (Bldg 350)

### Energy Calculations

The original energy savings were changed to correct for the following:

	<u>from:</u>		<u>to:</u>
	<u>RSH</u>	<u>BKA</u>	
Req'd CFM	42,150	53,450	53,450
Indoor temp.	68°F	varies	68°F
Boiler Sp. eff.	0.74	0.40	0.80
Opn. Hours			
# shifts	2	varies	2
days/wk	6	varies	5
Opn hrs. while Htg.	2270	-	3000

The results were taken from the "Paint and Drying Booth" Report by BKA, Vol. II, ppgs. 83-105.

### Existing energy use (p.90)

make-up air: (3000 opn hrs while heating)

$$2321 \times 2 \div 0.80 = \underline{5803} \text{ MBtu/yr. #6 FO}$$

Fan energy:

$$\frac{\$ 1933 \times 2}{0.0381 \text{ \$/kwh}} \cdot \frac{3413}{10^6} = \underline{346} \text{ MBtu/yr elec.}$$



SUBJECT Project I - Update  
LEAD  
DESIGNER PEH  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 2 OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

New energy use:

Make-up air (p. 89)

$$840 \times 2 \div 0.80 = \underline{2100} \text{ mBtu/yr. \#6}$$

Fan Energy (p. 89)

$$\begin{array}{r} \$ 8130 \times 2. \\ \hline 0.0381 \end{array} \quad \begin{array}{r} 3413 \\ \hline 106 \end{array} = \underline{1457} \text{ mBtu/yr. elec.}$$

Savings:

$$\text{\#6 F.O.} : 5803 - 2100 = \underline{3703} \text{ mBtu/yr}$$

$$\text{Elec} : 346 - 1457 = \underline{(1111)} \text{ mBtu/yr}$$

Cost Estimate: (p. 91)

$$\$ 189,030 \times 2 = \$ 378,060 \text{ (6/87)}$$

Escalate using ENR indices

$$\$ 378,060 \cdot \frac{2716}{2538} = \$ \underline{404,575} \text{ (1/91\$)}$$

$$\text{Payback} = \underline{404,575}$$

$$= \underline{32.8} \text{ yrs}$$
$$3703 \times 6.61 - 1111 \times 10.94$$



SUBJECT Project J-Update  
LEAD  
DESIGNER PFH  
CHECKER \_\_\_\_\_

AEP NO 290-0379-001  
SHEET 1 OF \_\_\_\_\_  
DATE 3/26/91  
DATE \_\_\_\_\_

ECO #J-UP Medium Paint Booth Exhaust Heat Recovery (#350)

Energy Calculations - Bldg 350 P.O.# 2527

The original energy savings values were changed to correct for the following:

	From		To:
	RS&H	BKA	
CFM	27,287	25,959	25,959
Indoor temp. (F)	80	varies	68
Boiler Sys. Eff.	0.74	0.40	0.80
Opn. Hrs.			
# shifts	1	varies	2
days/wk	5	varies	5
Opn while htg. (hrs)	1300	-	3000

The results were taken from the "Paint & Drying Booth Report", BKA, pp. 115-124, Vol II.

Existing Energy Use

Make up air :  $2254 \div 0.80 = 2818 \text{ MBtu/yr \#6 F.O.}$

Fan Energy :  $\frac{\$1779}{0.0381 \text{ \$/kwh}} \cdot \frac{3413 \text{ Btu}}{\text{kwh}} \cdot \frac{\text{MBtu}}{10^6 \text{ Btu}} = 159 \text{ MBtu/yr. elec}$

New Energy Use

Make up air :  $706 \div 0.80 = 883 \text{ MBtu/yr \#6 F.O.}$

Fan Energy :  $\frac{7426}{0.0381} \cdot \frac{3413}{10^6} = 665 \text{ MBtu/yr elec}$





SUBJECT Project J- Update  
P.B. 2527 Bldg 350 - LEAD  
DESIGNER PFL  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 2 OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

Fuel Savings:

2818 - 883

= 1935 M Btu/yr #6 F.O

Elec

159 - 665

= (506) M Btu/yr elec.

Capital Cost

Escalate 6/87 to 1/91

$$\$189,030 \cdot \frac{2716}{2538} = \$\underline{202,287}$$



SUBJECT Project J-Update  
LEAD  
DESIGNER PFH  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 3 OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

### Energy Calculations

Bldg 350 P.B. # 25/1

### Changes:

	<u>From</u>		<u>To</u>
	<u>RSH</u>	<u>BKA</u>	
CFM	24,000	27,156	27,156
Indoor Temp. (F)	80	Varies	65
Boiler Syst. Eff.	0.74	0.40	0.30
Opn Hrs.			
# shifts	1	varies	2
days/wk	5	varies	5
Opn. hrs while hty.	1300	-	2700

Results from BKA Report pp 125 - 134

### Existing Fuel Use

$$\text{Make-up air} : 2122 \div 0.80 = 2653 \text{ MBtu/yr } \#6\text{F.O.}$$

$$\text{Fan Energy} : \frac{\$1768}{0.0381} \cdot \frac{3413}{106} = 158 \text{ MBtu/yr elec.}$$

### New

$$\text{Make-up Air} : 755 \div 0.80 = 944 \text{ MBtu/yr } \#6\text{F.O.}$$

$$\text{Fan} : \frac{\$1435}{0.0381} \cdot \frac{3413}{106} = 662 \text{ MBtu/yr Elec.}$$



SUBJECT Project J-Update  
LEAD  
DESIGNER PEH  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 4 OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

Fuel Savings #6 FO.

$$2653 - 944 =$$

$$\underline{1709} \text{ MBtu/yr.}$$

Elec

$$158 - 662 =$$

$$\underline{(504)} \text{ MBtu/yr.}$$

Capital Cost

Escalate 6/87 to 1/91

$$\$189,030 \cdot \frac{2716}{2538} = \$\underline{202,287}$$

ECO UPDATE # N-UP

Window and wall insulation in Buildings 422, 424, 426, 433 & 436  
Assumptions:

1. The indoor air temperature is maintained at 68°F  
24 hrs/da, 7 da/wk during coldest winter mos., DEC-FEB.  
During spring & fall 63°F 8 hrs/da, 5 da/wk. Otherwise 50°F.
2. The heat loss factor is  
for infiltration. The average outdoor temperature  
while heating is 45°F. (See spreadsheet calculations  
using bin temperatures)
3. Existing wall U-value is 0.30 Btu/hr.ft<sup>2</sup>.°F.  
New wall U-Value (with insulation) is 0.13 Btu/hr.ft<sup>2</sup>.°F.  
Existing window U-value is 1.10 Btu/hr.ft<sup>2</sup>.°F.  
New window U-Value (with insulation) is 0.08 Btu/hr.ft<sup>2</sup>.°F.  
- Reference 1981 RS+H EEAP
4. The boiler/heating system efficiency is 30%.
5. Infiltration savings for insulation and weatherstripping:  
Walls => 0.054 cfm/ft<sup>2</sup> of wall area  
Windows => 0.54 cfm/linear foot of operable window area  
doors => 3.7 cfm/linear foot of door perimeter  
- Reference 1981 RS+H EEAP / ASHRAE Fundamentals, 1981
6. These buildings are heated 24 hours per day, 7 days  
per week. During the spring & fall the boiler  
pressures are reduced on nights and weekends. The result  
is lower indoor temperatures as discussed in (1).

Calculations:

$$Q = U \cdot A \cdot \Delta T \quad \text{conduction}$$

$$Q = \text{CFM} \cdot \text{HLF} \quad \text{infiltration}$$

The wall, window and door measurements were taken from the 1981 EEAP (Volume 4), entered on a spreadsheet for calculations. (Refer to attached spreadsheet)

$$\text{Wall area to be insulated} = 28,814 \text{ ft}^2$$

$$\text{Window area to be insulated} = 8,582 \text{ ft}^2$$

$$\text{window perimeter to be weatherstripped} = 5,735 \text{ ft}$$

$$\text{Door perimeter to be weatherstripped} = 1,024 \text{ ft}$$

Conduction Savings:

$$\begin{aligned} \text{Walls} &\Rightarrow 28,814 \text{ ft}^2 \times (0.30 - 0.13) \frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}} \times (80.1 + 27.3) \text{ kBtu/sf/}^\circ\text{F} \\ &= 526 \text{ MBtu/yr} \end{aligned}$$

$$\begin{aligned} \text{Windows} &\Rightarrow 8,582 \text{ ft}^2 \times (1.10 - 0.08) \frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}} \times (80.1 + 27.3) \text{ kBtu/sf/}^\circ\text{F} \\ Q_{\text{windows}} &= 940 \text{ MBtu/yr} \end{aligned}$$

$$\text{Infiltration Savings} : \text{HLF} = (86.5 + 29.5) = 116 \text{ kBtu/cfm/yr}$$

$$\text{Walls} \Rightarrow 28,814 \text{ ft}^2 \times 0.054 \frac{\text{CFM}}{\text{ft}^2} \times 0.116 \frac{\text{MBtu}}{\text{CFM} \cdot \text{yr}} = 180 \frac{\text{MBtu}}{\text{yr}}$$

$$\text{Windows} \Rightarrow 5,735 \text{ ft} \times 0.54 \frac{\text{CFM}}{\text{ft}} \times 0.116 \frac{\text{MBtu}}{\text{CFM} \cdot \text{yr}} = 36 \frac{\text{MBtu}}{\text{yr}}$$

$$\text{Doors} \Rightarrow 1,024 \text{ ft} \times 3.70 \frac{\text{CFM}}{\text{ft}} \times 0.116 \frac{\text{MBtu}}{\text{CFM} \cdot \text{yr}} = 517 \frac{\text{MBtu}}{\text{yr}}$$

733

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

WALL HEAT CONDUCTION PROGRAM - DECEMBER THRU FEBRUARY

Normal Building Temperature (F) 68  
 Building Setback Temperature (F) 68  
 Wall Area (sq ft) 1  
 U Value - Existing Wall 2.00  
           - New Wall 1.00  
           - Delta U 1.00

	Normal Hours	Setback Hours	Normal Hours	Setback Hours
Hour Fractions				
1 AM - 9 AM	1	0	0	1
9 AM - 5 PM	1	0	0	1
5 PM - 1 AM	1	0	0	1
Total Hours Per Day	24	0	0	24
Days Per Week	7	7	0	0
Total Normal Hours Per Week	168			

Temp. Range	Hours of Occurrence			Total Hours	Delta T		Heating Hours		Heating Load (kBtu)
	1-8	9-16	17-24		Norm	Setback	Norm	Setback	
70 74	0	0	0	0	0	0	0	0	0.00
65 69	0	0	1	1	1	1	1	0	0.00
60 64	1	5	4	10	6	6	10	0	0.06
55 59	6	10	8	24	11	11	24	0	0.26
50 54	8	27	14	49	16	16	49	0	0.78
45 49	14	56	33	103	21	21	103	0	2.16
40 44	50	116	84	250	26	26	250	0	6.50
35 39	135	169	161	465	31	31	465	0	14.42
30 34	178	150	178	506	36	36	506	0	18.22
25 29	133	85	112	330	41	41	330	0	13.53
20 24	71	58	63	192	46	46	192	0	8.83
15 19	58	29	72	159	51	51	159	0	8.11
10 14	51	12	17	80	56	56	80	0	4.48
5 9	15	3	9	27	61	61	27	0	1.65
0 4	9	0	2	11	66	66	11	0	0.73
-5 -1	3	0	1	4	71	71	4	0	0.28
-10 -6	1	0	0	1	76	76	1	0	0.08
-15 -11	0	0	0	0	81	81	0	0	0.00
Totals	733	720	759	2212			2212	0	80.09

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

WALL HEAT CONDUCTION PROGRAM - SPRING AND FALL

Normal Building Temperature (F) 68  
 Building Setback Temperature (F) 50  
 Wall Area (sq ft) 1  
 U Value - Existing Wall 2.00  
           - New Wall 1.00  
           - Delta U 1.00

		Normal Hours	Setback Hours	Normal Hours	Setback Hours
Hour Fractions	1 AM - 9 AM	0.25	0.75	0	1
	9 AM - 5 PM	0.75	0.25	0	1
	5 PM - 1 AM	0	1	0	1
Total Hours Per Day		8	16	0	24
Days Per Week		5	5	2	2
Total Normal Hours Per Week		40			

Temp. Range	Hours of Occurrence			Total Hours	Delta T		Heating Hours		Heating Load (kBtu)
	1-8	9-16	17-24		Norm	Setback	Norm	Setback	
70 74	5	46	25	76	0	0	26	50	0.00
65 69	15	71	48	134	1	0	41	93	0.04
60 64	36	102	75	213	6	0	61	152	0.37
55 59	73	137	117	327	11	0	86	241	0.95
50 54	116	151	143	410	16	0	102	308	1.63
45 49	150	145	163	458	21	3	104	354	3.25
40 44	174	128	160	462	26	8	100	362	5.49
35 39	182	87	129	398	31	13	79	319	6.60
30 34	129	42	70	241	36	18	46	195	5.16
25 29	63	12	22	97	41	23	18	79	2.55
20 24	21	4	7	32	46	28	6	26	1.00
15 19	6	0	1	7	51	33	1	6	0.25
10 14	0	0	0	0	56	38	0	0	0.00
5 9	0	0	0	0	61	43	0	0	0.00
0 4	0	0	0	0	66	48	0	0	0.00
-5 -1	0	0	0	0	71	53	0	0	0.00
-10 -6	0	0	0	0	76	58	0	0	0.00
-15 -11	0	0	0	0	81	63	0	0	0.00
Totals	970	925	960	2855			669	2186	27.28

# LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

## INFILTRATION PROGRAM - SPRING AND FALL

Normal Building Temperature (F) 68

Building Setback Temperature (F) 50

Infiltration (cfm) 1

		Normal Hours	Setback Hours	Normal Hours	Setback Hours
Hour Fractions	1 AM - 9 AM	0.25	0.75	0	1
	9 AM - 5 PM	0.75	0.25	0	1
	5 PM - 1 AM	0	1	0	1
Total Hours Per Day		8	16	0	24
Days Per Week		5	5	2	2
Total Normal Hours Per Week		40			

Temp. Range	Hours of Occurrence			Total Hours	Delta T		Heating Hours		Heating Load (kBtu)
	1-8	9-16	17-24		Norm	Setback	Norm	Setback	
70 74	5	46	25	76	0	0	26	50	0.00
65 69	15	71	48	134	1	0	41	93	0.04
60 64	36	102	75	213	6	0	61	152	0.40
55 59	73	137	117	327	11	0	86	241	1.03
50 54	116	151	143	410	16	0	102	308	1.76
45 49	150	145	163	458	21	3	104	354	3.51
40 44	174	128	160	462	26	8	100	362	5.93
35 39	182	87	129	398	31	13	79	319	7.13
30 34	129	42	70	241	36	18	46	195	5.57
25 29	63	12	22	97	41	23	18	79	2.75
20 24	21	4	7	32	46	28	6	26	1.08
15 19	6	0	1	7	51	33	1	6	0.27
10 14	0	0	0	0	56	38	0	0	0.00
5 9	0	0	0	0	61	43	0	0	0.00
0 4	0	0	0	0	66	48	0	0	0.00
-5 -1	0	0	0	0	71	53	0	0	0.00
-10 -6	0	0	0	0	76	58	0	0	0.00
-15 -11	0	0	0	0	81	63	0	0	0.00
Totals	970	925	960	2855			669	2186	29.47

N-UP-2C



# LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

## INFILTRATION PROGRAM - DECEMBER THROUGH FEBRUARY

Normal Building Temperature (F) 68

Building Setback Temperature (F) 68

Infiltration (cfm) 1

	Normal Hours	Setback Hours	Normal Hours	Setback Hours
Hour Fractions				
1 AM - 9 AM	1	0	0	1
9 AM - 5 PM	1	0	0	1
5 PM - 1 AM	1	0	0	1
Total Hours Per Day	24	0	0	24
Days Per Week	7	7	0	0
Total Normal Hours Per Week	168			

Temp. Range	Hours of Occurrence			Total Hours	Delta T		Heating Hours		Heating Load (kBtu)
	1-8	9-16	17-24		Norm	Setback	Norm	Setback	
70 74	0	0	0	0	0	0	0	0	0.00
65 69	0	0	1	1	1	1	1	0	0.00
60 64	1	5	4	10	6	6	10	0	0.06
55 59	6	10	8	24	11	11	24	0	0.29
50 54	8	27	14	49	16	16	49	0	0.85
45 49	14	56	33	103	21	21	103	0	2.34
40 44	50	116	84	250	26	26	250	0	7.02
35 39	135	169	161	465	31	31	465	0	15.57
30 34	178	150	178	506	36	36	506	0	19.67
25 29	133	85	112	330	41	41	330	0	14.61
20 24	71	58	63	192	46	46	192	0	9.54
15 19	58	29	72	159	51	51	159	0	8.76
10 14	51	12	17	80	56	56	80	0	4.84
5 9	15	3	9	27	61	61	27	0	1.78
0 4	9	0	2	11	66	66	11	0	0.78
-5 -1	3	0	1	4	71	71	4	0	0.31
-10 -6	1	0	0	1	76	76	1	0	0.08
-15 -11	0	0	0	0	81	81	0	0	0.00
Totals	733	720	759	2212			2212	0	86.49

N-UP-2d

$$\begin{aligned}\text{Heating Energy Savings} &= \sum \text{Cond. Savings} + \sum \text{Infil. Savings} \\ &= 526 + 940 + 180 + 36 + 517\end{aligned}$$

$$\text{Heating Energy Savings} = \underline{\underline{2199 \frac{\text{mbtu}}{\text{yr}}}}$$

Fuel Oil #5 Savings:

$$\text{Fuel Oil Savings} = \text{Energy Savings} \div \text{System Eff.}$$

$$= 2199 \frac{\text{mbtu}}{\text{yr}} \div 0.80$$

$$\text{Fuel Oil Savings} = \underline{\underline{2749 \text{ mbtu/yr}}}$$

Energy Cost Savings:

$$\text{Cost Savings} = 2749 \frac{\text{mbtu}}{\text{yr}} \times \$4.76/\text{mbtu}$$

$$\text{Cost Savings} = \underline{\underline{\$13,085/\text{yr}}}$$

Project Cost:

$$\text{Total Project Cost} = \$129,262 \quad \text{See Cost Estimate Sheets for details}$$

Simple Payback:

$$\text{Payback} = \$129,262 \div \$13,085/\text{yr} = \underline{\underline{9.9 \text{ years}}}$$

05/14/91

ECO Update Construction Cost Estimate  
Calculations

ECO Name: Window & Wall Insulation In Bldgs. 422, 424, 426, 433 & 436

ECO #: N-UP

Year of original cost estimate: 1980

ECO "bare" costs (from original cost estimate)

Material	\$19,508
Labor	\$32,041

Escalation to 1991

Escalation rates from Engineering News Record:

From 6/80 to 1/91 = 1.393

From 6/81 to 1/91 = 1.290

Material = \$19,508 x 1.393 = \$27,171

Labor = \$32,041 x 1.393 = \$44,627

Total = \$27,171 + \$44,627 = \$71,798

Bare 1991 Escalated Costs	\$71,798
FICA Insurance (20% of Labor)	\$8,925
Sales Tax (6.5% of Material)	\$1,766

Subtotal	\$82,489
Overhead (15%)	\$12,373

Subtotal	\$94,862
Profit (10%)	\$9,486

Subtotal	\$104,348
Bond (1%)	\$1,043

Subtotal	\$105,391
Contingency (10%)	\$10,539

Subtotal (Construction Cost Input For LCCID *)	\$115,930
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SIOH (5.5% of Construction Cost)	\$6,376
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Subtotal	\$122,306
Design (6% of Construction Cost)	\$6,956

Total Project Cost	\$129,262
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\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

N-UP-4



CONSTRUCTION COST ESTIMATE				DATE PREPARED 10-17-80		SHEET <u>N</u> -32F	
<b>PROJECT</b> ENERGY ENGINEERING ANALYSIS  <b>LOCATION</b> LETTERKENNY, CHAMBERSBURG, PA  <b>ARCHITECT ENGINEER</b> REYNOLDS, SMITH AND HILLS A.E.P., INC.				<b>BASIS FOR ESTIMATE</b> <input checked="" type="checkbox"/> CODE A (No design completed) <input type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____			
<b>DRAWING NO.</b> 400 SERIES		<b>ESTIMATOR</b> PULLIAM		<b>CHECKED BY</b>			
R 4.4	SUMMARY	QUANTITY		LABOR		MATERIAL	
		NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL
1" SPRAY-ON - LOWER HALF WITH FURRING & HARDBOARD:							
1" INSULATION	6000	S.F.	0.29	1740	0.20	1200	2940
1x3 FURRING	3000	S.F.	0.23	690	0.09	270	960
1/8" HARDBOARD	3000	S.F.	0.62	1860	0.24	720	2580
SUB-TOTAL				4290		2190	6480
LABOR BURDEN		22%		944		-	944
SALES TAX		5%		-		110	110
SUB-TOTAL				5234		2300	7534
O.H. & PROFIT		25%	7534				1884
BOND		1%	9418				94
CONTINGENCY		10%	9512				951
SIOW		5%	10463				523
TOTAL				10986	6000 =	\$1.83/S.F.	\$10986
#1.83/S.F.							
SPRAY-ON INSULATION ONLY:							
1-2" SPRAY-ON INSULATION						TOTAL \$ .82/S.F.	

CONSTRUCTION COST ESTIMATE					DATE PREPARED 10-7-50		SHEET VI-31 of	
PROJECT ENERGY ENGINEERING ANALYSIS					BASIS FOR ESTIMATE <input checked="" type="checkbox"/> CODE A (No design completed) <input type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____			
LOCATION LETTERKENNY, CHAMBERSBURG, PA.								
ARCHITECT ENGINEER REYNOLDS, SMITH AND HILLS A.E.P., INC.								
DRAWING NO.			ESTIMATOR		CHECKED BY			
SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST	
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL		
<b>COVER WINDOWS W/ METAL STUDS, 3" BATTS &amp; 1/8" HARDBOARD</b>								
SPRAY PAINT WINDOWS	1	S.F.	0.05	0.05	0.02	0.02	0.07	
1 5/8" METAL STUDS	1	S.F.	0.25	0.28	0.13	0.13	0.41	
3 1/2" BATT INSULATION	1	S.F.	0.10	0.10	0.18	0.18	0.28	
1/8" HARD BOARD	1	S.F.	0.62	0.62	0.24	0.24	0.86	
SUB-TOTAL				1.05		0.57	1.62	
LABOR BURDEN @ 22%				0.23			0.23	
SALES TAX @ 5%						0.03	0.03	
SUB-TOTAL				1.28		0.60	1.88	
O.H. & PROFIT @ 25%			1.88				0.47	
BOND @ 1%			2.35				0.02	
CONTINGENCY @ 10%			2.37				0.24	
S.I.O.H. @ 5%			2.61				0.13	
<b>TOTAL</b>				<b>\$ 2.74 / S.F.</b>		<b>2.74</b>		
<b>WEATHER-STRIPPING : Windows, and Personnel + Overhead Doors</b>								
WEATHERSTRIP WINDOWS						TOTAL	\$2.06/ft	
WEATHERSTRIP PERSONNEL DOORS						TOTAL	1.74/ft	
WEATHERSTRIP OVERHEAD DOORS						TOTAL	2.46/ft	

Letterkenny Army Depot

Insulate Wall And Windows - Buildings 422, 424, 426, 433 & 436

	Building #	422	424	426	433	436	Totals
1	Total Uninsulated Wall Area (SqFt)	12150	13920	8700	8863	0	43633
2	Total Window Area (SqFt)	3159	3725	4062	1072	978	12996
3	Total Door Area (SqFt)	722	646	448	985	237	3038
4	Total Wall Area Below 8' (SqFt)	3808	5568	5568	2800	2136	19880
5	Operable Window Area (SqFt)	1048	1154	1420	438	354	4414
6	Op. Window Perimeter (Ft)	1140	1597	1846	700	452	5735
7	Total Door Perimeter (Ft)	210	338	240	300	116	1204
8	Overhead Door Perimeter (Ft)	144	294	196	240	96	970
9	Wall Area For Insulation (1-2-3)	8269	9549	4190	6806	0	28814
10	Wall Area For Hardboard (4-3-5)	2038	3768	3700	1377	1545	12428
11	Window Area For Insulation (2-5)	2111	2571	2642	634	624	8582
12	Window Perimeter For W-strip (6)	1140	1597	1846	700	452	5735
13	Door Perimeter For W-strip (7)	210	338	240	300	116	1204

Conduction Savings

	Area	dU	dT	Hr/Yr	Savings
Insulate Walls	28814	0.17	23	6687	753.4 Mbtu/Yr
Insulate Windows	8582	1.02	23	6687	1346.3 Mbtu/Yr
Subtotal					2099.7 Mbtu/Yr

Infiltration Savings

	Area or Length	Cfm Reduction	HLF	Savings
Insulate Walls	28814 SqFt	0.054 Cfm/SF	0.17	258.1 Mbtu/Yr
W-Strip Windows	5735 Ft	0.54 Cfm/Ft	0.17	513.8 Mbtu/Yr
W-Strip Doors	1204 Ft	3.7 Cfm/Ft	0.17	739.1 Mbtu/Yr
Subtotal				1510.9 Mbtu/Yr
Total				3610.6 Mbtu/Yr

SUMMARY

Heating Energy Savings	3610.6 Mbtu/Yr
Fuel Oil Savings	4513.2 Mbtu/Yr
Energy Cost Savings	29832 \$/Year
Total Project Cost	129645 \$
Simple Payback	4.3 Years

# LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 24

Room or Supply Air Conditions - Winter 68  
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 1  
9 AM - 5 PM 1  
5 PM - 1 AM 1

Operation Days Per Week 7

Temp. Range		Hours of Occurrence			Total Hours	Delta T	Const.	CFM	Btu /Hr	Total Btu
		2-9	10-17	18-1						
70	74	247	237	301	785	-4	1.08	1	0	0
65	69	296	217	278	791	1	1.08	1	1	854
60	64	269	196	236	701	6	1.08	1	6	4,542
55	59	249	191	209	649	11	1.08	1	12	7,710
50	54	221	193	202	616	16	1.08	1	17	10,644
45	49	218	193	206	617	21	1.08	1	23	13,994
40	44	237	236	239	712	26	1.08	1	28	19,993
35	39	289	246	286	821	31	1.08	1	33	27,487
30	34	304	194	258	756	36	1.08	1	39	29,393
25	29	184	106	152	442	41	1.08	1	44	19,572
20	24	124	65	90	279	46	1.08	1	50	13,861
15	19	75	32	57	164	51	1.08	1	55	9,033
10	14	54	13	26	93	56	1.08	1	60	5,625
5	9	18	3	9	30	61	1.08	1	66	1,976
0	4	9	0	2	11	66	1.08	1	71	784
-5	-1	3	0	1	4	71	1.08	1	77	307
-10	-6	1	0	0	1	76	1.08	1	82	82
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	7472					165,858

Net heat loss corrected for working days/week (Btu/cfm\*yr) = 165,858

Total Operation Hours While Heating  
(and corrected for working days/week) = 6687

Average outdoor temperature while heating = 45.0 F



## ECO UPDATE # R-UP

Replace Mercury Vapor lights with High Pressure Sodium in  
Buildings 31, 32, 33, 34, 41, 42, 43 & 44

This project was originally designed for replacement of Fluorescent and mercury vapor lighting with new high pressure sodium lighting. Due to the high initial cost and low savings potential the payback was 118.9 years.

In this re-analysis the Fluorescent fixtures are not considered for replacement due to the low watt per fixture difference between them and the HPS fixtures. Assume 1 shift per day operation.

Current energy use:

There are 873 fixtures in the subject buildings utilizing 175w-Mercury vapor lamps.

The total input watts per fixture (with ballasts) is 205 watts.

$$873 \text{ Fixt.} \times 205 \frac{\text{watt}}{\text{Fixt.}} \times \frac{1 \text{ Kw}}{1000 \text{ w}} \times 2080 \frac{\text{hr}}{\text{yr}} = 372,247 \text{ Kwh/yr}$$

Energy Consumption with 100w HPS fixtures:

Total input watts with ballast = 130 watts/fixture

$$873 \text{ Fixt.} \times 130 \frac{\text{w}}{\text{Fixt.}} \times \frac{1 \text{ Kw}}{1000 \text{ w}} \times 2080 \frac{\text{hr}}{\text{yr}} = 236,059 \text{ Kwh/yr}$$

SUBJECT Change MV to HPS Lights  
LEAD  
DESIGNER W. T. Todd  
CHECKER \_\_\_\_\_

AEP NO. \_\_\_\_\_  
SHEET 2 OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

Energy Savings :

$$372,247 \frac{\text{kwh}}{\text{yr}} - 236,059 \frac{\text{kwh}}{\text{yr}} = \underline{136,188 \frac{\text{kwh}}{\text{yr}}}$$

$$136,188 \frac{\text{kwh}}{\text{yr}} \times 3413 \frac{\text{Btu}}{\text{kwh}} \times \frac{1 \text{ MBtu}}{10^6 \text{ Btu}} = \underline{464.8 \frac{\text{MBtu}}{\text{yr}}}$$

Energy Cost Savings:

$$464.8 \frac{\text{MBtu}}{\text{yr}} \times 10.94 \frac{\$}{\text{MBtu}} = \underline{\$5,085 / \text{yr}}$$

Implementation Cost :

$$\text{Total Project Cost} = \underline{\$303,532}$$

See cost estimate sheets for details

Simple Payback :

$$\text{Payback} = \$303,532 \div \$5,085 / \text{yr} = \underline{59.7 \text{ years}}$$

05/14/91

ECO Update Construction Cost Estimate  
Calculations

ECO Name: HPS Lighting In Buildings 31, 32, 33, 34, 41, 42, 43 & 44

ECO #: R-UP

Year of original cost estimate: 1980

ECO "bare" costs (from original cost estimate)

Material	\$87,300
Labor	\$38,412

Escalation to 1991

Escalation rates from Engineering News Record:

From 6/80 to 1/91 = 1.393

From 6/81 to 1/91 = 1.290

Material = \$87,300 x 1.393 = \$121,593

Labor = \$38,412 x 1.393 = \$53,501

Total = \$121,593 + \$53,501 = \$175,094

Bare 1991 Escalated Costs	\$175,094
FICA Insurance (20% of Labor)	\$10,700
Sales Tax (6.5% of Material)	\$7,904

Subtotal	\$193,698
Overhead (15%)	\$29,055

Subtotal	\$222,753
Profit (10%)	\$22,275

Subtotal	\$245,028
Bond (1%)	\$2,450

Subtotal	\$247,478
Contingency (10%)	\$24,748

Subtotal (Construction Cost Input For LCCID *)	\$272,226
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SIOH (5.5% of Construction Cost)	\$14,972
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Subtotal	\$287,198
Design (6% of Construction Cost)	\$16,334

Total Project Cost	\$303,532
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\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

# CONSTRUCTION COST ESTIMATE

DATE PREPARED

4-25-91

SHEET

OF

PROJECT

ENERGY ENGINEERING ANALYSIS

LOCATION

Letterkenny Army Depot

ARCHITECT ENGINEER

REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE

- ☒ CODE A (No design completed)  
☐ CODE B (Preliminary design)  
☐ CODE C (Final design)  
☐ OTHER (Specify) \_\_\_\_\_

DRAWING NO.

ESTIMATOR

W.T. Todd

CHECKED BY

P. Hutchins

Change MV to HPS SUMMARY

QUANTITY

LABOR

MATERIAL

NO.  
UNITS

UNIT  
MEAS.

PER  
UNIT

TOTAL

PER  
UNIT

TOTAL

TOTAL  
COST

100 w HPS Lamps and

Fixtures \*

873

EA.

44

38412

100

87300

\$125,712

(includes removal of  
MV fixture)

\* Source - 1980  
(see R-UP-6210)

Cost Estimate from Letterkenny EEAP

Letterkenny Army Depot  
 Lighting Modifications  
 Buildings 31, 32, 33, 34, 41, 42, 43 & 44

04/25/91

Building No.	Existing			Proposed	
	2-40w Fl	4-40w FL	175w MV	70w HPS	100w HPS
31	0	0	165	0	165
32	0	0	165	0	165
33	0	0	0	0	0
34	0	0	165	0	165
41	0	0	165	0	165
42-S	0	0	15	0	15
42-N	0	0	33	0	33
43	0	0	0	0	0
44	0	0	165	0	165
Total Fixt.	0	0	873	0	873
Input Watts	92	184	205	88	130
Total Watts	0	0	178965	0	113490
Total KW	0.0	0.0	179.0	0.0	113.5
Hours/Year	2080	2080	2080	2080	2080
KWH/Year	0	0	372247	0	236059

SUMMARY

	Existing	Proposed	Savings
Total Annual KWH	372247	236059	136188 Kwh/Yr
Annual Energy Cost	13885	8805	\$5,080
Annual Maint. Cost	0	0	\$0
Total Annual Cost	13885	8805	\$5,080

R-UP-5



**REYNOLDS, SMITH & HILLS**  
 ARCHITECTS ENGINEERS PLANNERS

PROJECT MODIFICATION TO BLDG. 42		SHEET _____ OF _____	
LOCATION LEETTERKENNY ARMY DEPOT, CHAMBERSBURG, PA.		A E FILE NO.	
CONSTRUCTION COST ESTIMATE		DATE 10/6/80	
BASIS FOR ESTIMATE <input checked="" type="checkbox"/> PRE-DESIGN STUDY <input type="checkbox"/> SCHEMATIC DESIGN <input type="checkbox"/> DESIGN DEVELOPMENT <input type="checkbox"/> FINAL DESIGN		ESTIMATOR RLS	
		CHECKER	

ITEM NO.	DESCRIPTION	NO. OF UNITS	UNIT	UNIT PRICE	ESTIMATED COST
	SOUTH PART				
	REMOVAL OF EXISTING FIXTURES				
	175 W. MERCURY VAPOR (L)	15	EA.	4	60.00
	2-LAMP 4 FT. FLUOR. (L)	66	EA.	4	264.00
	4-LAMP 4 FT. FLUOR. (L)	20	EA.	4	80.00
	REPLACEMENT WITH H.P.S. FIXT. (L)	54	EA.	40	2160.00
	(M)	54	EA.	100	5400.00
	1/2" CONDUIT (54x15')	810	L.F.	.1388	112.43
	(M)	810	L.F.	.66	534.60
	#12 WIRE (54x15x2)	1620	L.F.	.1024	165.89
	(M)	1620	L.F.	.0793	128.47
	2 FT. CONDUIT STEM 3/4" RGS (L)	54	EA.	12.61	680.94
	ETC. (M)	54	EA.	4.49	242.46
	NORTH PART				
	REMOVE EXISTING FIXT.				
	4-LAMP 4 FT. FLUOR. (L)	10	EA.	4	40.00
	175 W. MERCURY VAPOR (L)	33	EA.	4	132.00
	REPLACE WITH H.P.S. FIXT (L)	43	EA.	40	1720.00
	(LOW-BAY) (M)	43	EA.	100	4300.00
	CONDUIT STEMS 2' RGS (L)	10	EA.	12.61	126.10
	(M)	10	EA.	4.49	44.90
	TOTAL BLDG. 42 LABOR (L)				5541.36
	MATERIAL (M)				10,650.43

R-1V25 of V39

RSB 52A .PR 70)

R-VP-8



1-1V26 or V39

**REYNOLDS, SMITH & HILLS**  
ARCHITECTS      ENGINEERS      PLANNERS

<b>PROJECT</b>	MODIFICATION TO BLDGS. 31, 32, 33, 34, 41, 42, 43, 44	SHEET _____ OF _____
<b>LOCATION</b>	LETTERKENNY ARMY DEPOT, CHAMBERSBURG, PA.	A E FILE NO.
<b>CONSTRUCTION COST ESTIMATE</b>		DATE 10/6/80
<b>BASIS FOR ESTIMATE</b> <input checked="" type="checkbox"/> PRE-DESIGN STUDY <input type="checkbox"/> SCHEMATIC DESIGN <input type="checkbox"/> DESIGN DEVELOPMENT <input type="checkbox"/> FINAL DESIGN		ESTIMATOR RLS
		CHECKER

ITEM NO.	DESCRIPTION	NO. OF UNITS	UNIT	UNIT PRICE	ESTIMATED COST
	<u>BLDG. NO.</u>			<u>Labor</u>	<u>MATERIAL</u>
	31			7260	16,500.
	32			7260	16,500.
	33			14,555	26,317.50
	34			7260	16,500.
	41			7260	16,500.
	42			5541.36	10,650.48
	43			14,555.00	26,317.50
	44			7260	16,500.
	<b>TOTAL</b>			<b>70,951.86</b>	<b>145,785.43</b>
	<b>+ LABOR, FICA &amp; OTHER TAXES @ 22%.</b>			<b>15,609.30</b>	
				<b>86,560.66</b>	
	<b>+ SALES TAX @ 5%.</b>				<b>7289</b>
					<b>153,075</b>
	<b>TOTAL LABOR + MAT'L</b>				<b>239,636</b>
	<b>+ CONTRACTOR'S OH &amp; PROFIT @ 25%.</b>				<b>59,909</b>
					<b>299,545</b>
	<b>+ BOND @ 1%.</b>				<b>2995</b>
					<b>302,540</b>
	<b>+ CONTINGENCIES @ 10%.</b>				<b>30,254</b>
					<b>332,794</b>
	<b>+ SIOH @ 5%.</b>				<b>16,649</b>
	<b>TOTAL C.W.E. (FY 80)</b>				<b>349,434</b>
	<b>TOTAL</b>				

RSH 52A .PR 70)

TABLE I-1

COMPARISON OF EXISTING AND PROPOSED LIGHTING SYSTEMS  
FOR BUILDINGS 31, 32, 33, 34, 41, 42, 43, and 44

BUILDING	EXISTING FIXTURES <sup>1</sup>			PROPOSED FIXTURES	
	FLUORESCENT		MERCURY 175 Watt	HIGH PRESSURE SODIUM	
	2-F40	4-F40		70 Watt	100 Watt
31			165		165
32			165		165
33	250			250	
34			165		165
41			165		165
42 (South)	66	20	15		54
42 (North)		10	33		43
43	250			250	
44			165		165

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<sup>1</sup>Existing fixtures from field survey.

Letterkenny Army Depot  
 Lighting Modifications  
 Buildings 31, 32, 33, 34, 41, 42, 43 & 44

04/25/91

Building No.	Existing			Proposed	
	2-40w Fl	4-40w FL	175w MV	70w HPS	100w HPS
31	0	0	165	0	165
32	0	0	165	0	165
33	250	0	0	250	0
34	0	0	165	0	165
41	0	0	165	0	165
42-S	66	20	15	0	54
42-N	0	10	33	0	43
43	250	0	0	250	0
44	0	0	165	0	165
Total Fixt.	566	30	873	500	922
Input Watts	92	184	205	88	130
Total Watts	52072	5520	178965	44000	119860
Total KW	52.1	5.5	179.0	44.0	119.9
Hours/Year	2080	2080	2080	2080	2080
KWH/Year	108310	11482	372247	91520	249309

SUMMARY

	Existing	Proposed	Savings
Total Annual KWH	492039	340829	151210 Kwh/Yr
Annual Energy Cost	18353	12713	\$5,640
Annual Maint. Cost	4955	9064	(\$4,109)
Total Annual Cost	23308	21777	\$1,531



SUBJECT Project G-E Update  
Paint Booth Exh Heat Rec  
DESIGNER PFH  
CHECKER W.T. Todd

AEP NO 290-0379-001  
SHEET 1 OF 1  
DATE 4/23/91  
DATE \_\_\_\_\_

ECO # G-E-UP Paint Booth Exhaust Heat Recovery - Bldg 1N

Energy Calculations

P.B # 1010

The original energy savings were changed to correct for the following.

	<u>From:</u>		<u>TO:</u>
	<u>RS&amp;H</u>	<u>BKA</u>	
Req'd cfm	16,717	14,400	14,400
Indoor temp.	30°F	varies	68°F
Boiler Sup. Eff.	0.74	0.65	0.80
Opn. Hours			
# Shifts	1	varies	1
Days/wk	5	varies	5
Opn hrs. while htg.	1300	-	1450

Ref: "E&AP Increment G", Vol 2, p. E-I-1 (RS&H)  
"Paint and Drying Booth Report", Vol II, pp. 1-11 (BKA)

The results were taken from the BKA Report

Existing energy use (p. 8)

Make-up air/htg. (1450 opn. hrs while heating, 68°F)

$$603 \div 0.80 = \underline{754} \text{ MBtu/yr} \quad \# 5 \text{ f.o.}$$

Fan energy

$$\frac{\$493}{0.0381 \text{ \$/kwh}} \cdot \frac{3413}{10^6} = \underline{44} \text{ MBtu/yr elec}$$



SUBJECT Project G-E Update  
P.B. 1010 Bldg 1N  
DESIGNER PFH  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 2 OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

### New Energy Use

#### Make-up air (p. 7)

$$195 \div 0.80 = \underline{244} \text{ MBtu/yr} \#5 \text{ F.O.}$$

#### Fan energy (p. 7)

$$\frac{2060}{0.0381} \times \frac{3413}{10^6} = \underline{185} \text{ MBtu/yr elec.}$$

### Savings

$$\#5 \text{ F.O.} : 754 - 244 = 510 \text{ MBtu/yr}$$

$$\text{Elec} : 44 - 185 = (141) \text{ MBtu/yr.}$$

### Cost Estimates (p. 9) Escalate using ENR indices

$$\# 119,052 \text{ (6/87\$)} \times \frac{2716}{2538} = \underline{\$127,402} \text{ (1/91\$)}$$

$$\text{Payback} = \frac{\$127,402}{510 \times 6.61 + 141 \times 10.94} =$$
$$\frac{127,402}{1829} = \underline{69.9 \text{ yrs.}}$$



SUBJECT Project G-F Update  
Paint Booth Exh. Ht. Recovery  
DESIGNER PH.  
CHECKER W.T. Todd

AEP NO 290-0379-001  
SHEET 1 OF 1  
DATE 4/25/91  
DATE \_\_\_\_\_

ECO #G-F-UP Paint Booth Exhaust Heat Recovery

Energy Calculations

Bldg # 14  
P. B. # 252

The original energy savings were changed to correct for the following:

	<u>From:</u>		
	<u>RSH</u>	<u>BKA</u>	<u>To:</u>
Req'd CFM	12,970	9221	9221
Indoor Temp.	80°F	varies	68°F
Boiler Sys. Eff.	0.74	0.65	0.80
Opn. Hrs			
# shifts	1	varies	1
days/wk	5	varies	5
Opn hrs. while hty.	1300	-	1450

Ref: "EEAP, Increment G, Vol 2", RSH, p. F-V-1 &  
"Paint and Drying Booth Report", Vol II, BKA, p. 12-21

The following results were taken from the BKA Report

Existing energy use: (p. 18)

Make-up air heating

$$386 \div 0.80 = \underline{483} \text{ MBtu/yr } \# 5 \text{ F.O.}$$

Fan Energy

$$\frac{\# 316}{0.0381 \text{ \$/kwh}} \cdot \frac{3413}{10^6} = \underline{28} \text{ MBtu/y Elec}$$



SUBJECT Project G-F Update  
P.B. #252 Bldg 14  
DESIGNER PH  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 2 OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

### New Energy Use

Make-up air heating (p. 17)

$$126 \div 0.8 = 158 \text{ MBtu/yr } \#5 \text{ F.O.}$$

Fan energy

$$\frac{\$1319}{0.0381} \cdot \frac{3413}{106} = 118 \text{ MBtu/yr Elec.}$$

### Savings

$$\#5 \text{ F.O.} : 483 - 158 = 325 \text{ MBtu/yr}$$

$$\text{Elect.} : 28 - 118 = (90) \text{ MBtu/yr}$$

Cost Estimates (p. 19) Escalate using ENR indices

$$\frac{\$96,396}{(6/87\#)} + \frac{2716}{2538} = \$103,157 \text{ (1/91\#)}$$

$$\text{Payback} = \frac{103,157}{325 * 6.61 - 90 * 10.94}$$

$$= \frac{103,157}{1164} = 88.6 \text{ yrs}$$



SUBJECT Project G-G Update  
Paint Booth Exh. Ht Recovery  
DESIGNER P. Hutchins  
CHECKER W.T. Todd

AEP NO 290-0379-001  
SHEET 1 OF 1  
DATE 4/25/91  
DATE \_\_\_\_\_

ECO # G-G-UP Paint Booth Exhaust Heat Recovery

Energy Calculation

Bldg. # 37  
P.B. # 486

The original energy savings were changed to correct for the following:

	From:		To:
	RSH	BKA	
Req'd CFM	12,886	11,152	11,152
Indoor Temp.	80°F	varies	68°F
Boiler Sep. Eff.	0.74	0.65	0.80
Opn Hrs			
# shifts	1	-	1
days/wk	5	-	5
Opn hrs while htg.	1300	varies	1450

Ref.: "E&AP, Increment G, Vol 2" RSH, p. G-  
"Paint and Drying Booth Report", Vol II, BKA, p. 32-42

The following results were taken from the BKA Report

Existing energy use: (p. 33)

$$\text{Make-up air heating} - 467 \div 0.80 = 583 \frac{\text{MBtu}}{\text{yr}} \text{ F.O.} \#5$$

$$\text{Fan energy} - \frac{\$382}{0.0381 \text{ \$/kwh}} \cdot \frac{.3413}{10^6} = 34 \frac{\text{MBtu Elec}}{\text{yr}}$$





SUBJECT Project G-G Update  
Bldg 37 P.B. #486  
DESIGNER PFH  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 2 OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

### New Energy Use (p. 37)

$$\text{Make-up air hty} - 152 \div 0.80 = \underline{190} \text{ MBtu} \#5 \text{ F.O.} \frac{\text{yr}}{\text{yr}}$$

$$\text{Fan energy} - \frac{\$1595}{0.0381} \cdot \frac{3413}{10^6} = \underline{143} \text{ MBtu Elec.} \frac{\text{yr}}{\text{yr}}$$

### Energy Savings

$$\#5 \text{ F.O.} - 583 - 190 = \underline{393} \text{ MBtu} \#5 \text{ F.O.} \frac{\text{yr}}{\text{yr}}$$

$$\text{Elec.} - 34 - 143 = \underline{(109)} \text{ MBtu Elec.} \frac{\text{yr}}{\text{yr}}$$

### Cost Estimates (p. 39) Escalate using ENR indices

$$\$119,053 (6/87\$) * \frac{2716}{2538} = \$127,403 (1/91\$)$$

$$\text{Payback} = \frac{\$127,403}{393 * 6.61 - 109 * 10.94}$$

$$= \frac{127,403}{1405} = \underline{91} \text{ years}$$



SUBJECT LETTER KENNY A.D.  
ECO # G-I-UP  
DESIGNER G.F.  
CHECKER \_\_\_\_\_

AEP NO 290-0379-001  
SHEET 1 OF 2  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

ECO # G-I-UP

UPDATE BUILDING 350 SOUTH DIP TANK HEAT RECOVERY.

<u>ASSUMPTIONS</u>	<u>1981 ①</u> <u>(MEASURED)</u>	<u>1991 ②</u> <u>(DESIGN)</u>
EXHAUST FLOW (CFM)	7557	11,000
EXHAUST TEMP (°F)	80	63
BOILER EFF	0.74	0.80
OPN HRS	1465	1465

- ① LEAD EEAP, RSH 1980, INCREMENT 4, VOL. 2, PG I-IV-1  
② LEAD DIP TANK SURVEY. LEAD BLDG DESIGN TEMPERATURES.

ENERGY REQUIRED TO HEAT EXHAUST AIR

$$Q = \frac{35618 \text{ BTU/YR/CFM} \times 11000 \text{ CFM}}{10^6 \text{ BTU/MBTU}} = 392 \text{ MBTU/YR}$$

NOTE: 35618 BTU/YR/CFM WAS DERIVED USING BIN TEMP. METHOD. SEE PAGE G-I-UP-3

ENERGY RECOVERED WITH HEAT EXCHANGER

$$Q_R = Q_E \times \eta_{HX}$$

WHERE:  $Q_R$  = ENERGY RECOVERED

$Q_E$  = ENERGY EXHAUSTED

$\eta_{HX}$  = EFFICIENCY OF HEAT EXCHANGER

= 0.69, PG I-IV-3 OF EEAP

$$Q_R = 392 \text{ MBTU/YR} \times 0.69$$

$$= 270 \text{ MBTU/YR.}$$

FUEL SAVED

$$270 \text{ MBTU/YR} / 0.8 = 338 \text{ MBTU/YR} \quad \#6 \text{ F.O.}$$

G-I-UP-1



SUBJECT LETTER KENNY A.D.  
ECO # G-I-UP  
DESIGNER G.F.  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 2 OF 2  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

FUEL COST SAVINGS

$$339 \text{ MBTU/YR} \times 6.61 \text{ \$/MBTU} = 2230 \text{ \$/yr}$$

ELECTRICITY

ADDITIONAL FAN ENERGY REQUIRED

FAN ENERGY IS DIRECTLY PROPORTIONAL TO FLOW. JRI 11-1-81  
CALC'S SHOW 53.6 MBTU/YR (ELEC) TO MOVE 7557 CFM AIR.

$$Q_{\text{ELEC}} = 53.6 \frac{\text{MBTU}}{\text{YR}} \times \frac{11,000 \text{ CFM}}{7557 \text{ CFM}} = 78.0 \text{ MBTU/YR}$$

ADDITIONAL FAN ENERGY COST

$$78 \text{ MBTU/YR} \times 10.94 \frac{\text{\$}}{\text{MBTU}} = 854 \text{ \$/yr ADDITIONAL}$$

NET COST SAVINGS

$$2230 \text{ \$/yr} - 854 \text{ \$/yr} = 1380 \text{ \$/yr}$$

PAYBACK

$$\text{PAYBACK} = \frac{\text{CONSTRUCTION COST}}{\text{ANNUAL SAVINGS}} = \frac{\$42,405}{\$1380/\text{yr}} = 30.8 \text{ YEARS.}$$

05/09/91

ECO Update Construction Cost Estimate  
Calculations

ECO Name: Building 350s dip tank heat exhaust recovery - update

ECO #: G-I-UP

Year of original cost estimate: 1981

ECO "bare" costs (from original cost estimate)

Material

\$13,766

Labor

\$5,269

Escalation to 1991

Escalation rates from Engineering News Record:

From 6/80 to 1/91 = 1.393

From 6/81 to 1/91 = 1.290

Material = \$13,766 x 1.290 = \$17,753

Labor = \$5,269 x 1.290 = \$6,795

Total = \$17,753 + \$6,795 = \$24,548

Bare 1991 Escalated Costs

\$24,548

FICA Insurance (20% of Labor)

\$1,359

Sales Tax (6.5% of Material)

\$1,154

Subtotal

\$27,061

Overhead (15%)

\$4,059

Subtotal

\$31,120

Profit (10%)

\$3,112

Subtotal

\$34,232

Bond (1%)

\$342

Subtotal

\$34,574

Contingency (10%)

\$3,457

Subtotal (Construction Cost Input For LCCID \*)

\$38,031

SIOH (5.5% of Construction Cost)

\$2,092

Subtotal

\$40,123

Design (6% of Construction Cost)

\$2,282

Total Project Cost

\$42,405

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

G-I-UP-3

## LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 8

Room or Supply Air Conditions - Winter 68  
 Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 0.25  
 9 AM - 5 PM 0.75  
 5 PM - 1 AM 0

Operation Days Per Week 5

Temp. Range	Hours of Occurrence			Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
	2-9	10-17	18-1						
70	74	247	237	301	240	-4	1.08	1	0
65	69	296	217	278	237	1	1.08	1	256
60	64	269	196	236	214	6	1.08	1	1,388
55	59	249	191	209	206	11	1.08	1	2,441
50	54	221	193	202	200	16	1.08	1	3,456
45	49	218	193	206	199	21	1.08	1	4,519
40	44	237	236	239	236	26	1.08	1	6,634
35	39	289	246	286	257	31	1.08	1	8,596
30	34	304	194	258	222	36	1.08	1	8,612
25	29	184	106	152	126	41	1.08	1	5,557
20	24	124	65	90	80	46	1.08	1	3,962
15	19	75	32	57	43	51	1.08	1	2,355
10	14	54	13	26	23	56	1.08	1	1,406
5	9	18	3	9	7	61	1.08	1	445
0	4	9	0	2	2	66	1.08	1	160
-5	-1	3	0	1	1	71	1.08	1	58
-10	-6	1	0	0	0	76	1.08	1	21
-15	-11	0	0	0	0	81	1.08	1	0
-----									=====
Totals	2798	2122	2552	2291					49,865

Total Operation Hours While Heating  
 (and corrected for working days/week) 1465 35,618

Avg outdoor temp while heating (F) 45.0



SUBJECT LETTERKENNY A.D.  
ECO #J-UP  
DESIGNER G.F.  
CHECKER \_\_\_\_\_

AEP NO 290-0379-001  
SHEET 1 OF 2  
DATE 4-25-91  
DATE \_\_\_\_\_

ECO G-J-UP - BLDG 320 STEAM SUPPLY

1990 BLDG 320 FUEL CONSUMPTION (#2 OIL)

MO	<u>OCT</u>	<u>NOV</u>	<u>DEC</u>	<u>JAN</u>	<u>FEB</u>	<u>MAR</u>	<u>APR</u>	<u>MAY</u>
GAL	6844	8494	3607	21073	6236	10041	2415	4535
MBTU	949	1180	500	2920	865	1390	335	636

	<u>YEAR</u>	<u>GAL</u>	<u>MBTU</u>
TOTAL	1990	63295	8780

ASSUME : a) EQUAL BOILER EFFICIENCIES = 80%  
b) EQUAL ELECTRICAL CONSUMPTION

COST OF NO. 2 FUEL OIL

$$8780 \text{ MBTU/YR} \times \$7.43/\text{MBTU} = \$65,200/\text{YR}$$

COST OF NO. 6 FUEL OIL

$$8780 \text{ MBTU/YR} \times \$6.61/\text{MBTU} = \$58,000/\text{YR}$$

COST SAVINGS

$$\$65,200/\text{YR} - \$58,000/\text{YR} = \$7,160/\text{YR}$$

05/14/91

# ECO Update Construction Cost Estimate Calculations

ECO Name: Building 320 steam line

ECO #: G-J-UP

Year of original cost estimate: 1981

ECO "bare" costs (from original cost estimate)

Material	\$340,499
Labor	\$135,510

Escalation to 1991

Escalation rates from Engineering News Record:

From 6/80 to 1/91	=	1.393
From 6/81 to 1/91	=	1.290

Material	=\$340,499 x	1.290	=\$439,124
Labor	=\$135,510 x	1.290	=\$174,760
Total	=\$439,124	+\$174,760	=\$613,884

Bare 1991 Escalated Costs	\$613,884
FICA Insurance (20% of Labor)	\$34,952
Sales Tax (6.5% of Material)	\$28,543

Subtotal	\$677,379
Overhead (15%)	\$101,607

Subtotal	\$778,986
Profit (10%)	\$77,899

Subtotal	\$856,885
Bond (1%)	\$8,569

Subtotal	\$865,454
Contingency (10%)	\$86,545

Subtotal (Construction Cost Input For LCCID *)	\$951,999
--	-----------

SIOH (5.5% of Construction Cost)	\$52,360
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Subtotal	\$1,004,359
Design (6% of Construction Cost)	\$57,120

Total Project Cost	\$1,061,479
--------------------	-------------

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

ECO UPDATE # G-N-UP

Install warehouse door seals on Buildings 2 & 4

### Assumptions

1. The space temperature is maintained at 68°F during the heating season.
2. The boiler system efficiency is 80%.
3. Buildings 2 and 4 are heated 24 hours per day, 7 day per week.
4. The average winter wind velocity is 10 mph. (1987 Statistical Abstract of the United States)
5. The average crack width is 1/2" around the top and sides of the sliding and roll-up doors. The crack width at the bottom is 1/2" for the sliding doors and 1/4" for the roll-up doors.
6. Installing warehouse door seals will reduce the crack width by 50%.
7. Building 2 is heated by #5 fuel oil from the boilers in building 1. Building 4 is heated by #2 fuel oil from the boilers in building 2.

### Infiltration Rate

$$I = C_v \times A \times V \quad \text{ASHRAE Fundamentals, 1981, pg. 22.6}$$

$$C_v = \text{Wind direction factor} = 0.35 \text{ for diagonal wind}$$

G-N-UP-1



$$V = \text{Wind velocity} = 10 \frac{\text{mi}}{\text{hr}} \times 5280 \frac{\text{ft}}{\text{mi}} \times \frac{1 \text{ hr}}{60 \text{ min}} = 880 \text{ ft/min}$$

$$A = \text{Area of opening} = \text{perimeter} \times \text{crack width}$$

Building 2 has : 32 Roll-up doors, 8' x 10.25'  
6 " " " 10' x 10.25'  
5 " " " 12' x 10.25'  
1 " " " 16' x 10.25'

$$A_2 = [32 \times (8 \text{ ft} + 2 \times 10.25 \text{ ft}) + 6 \times (10 \text{ ft} + 2 \times 10.25 \text{ ft}) + 5 \times (12 \text{ ft} + 2 \times 10.25 \text{ ft}) + 16 \text{ ft} + 2 \times 10.25 \text{ ft}] \times 0.5 \text{ in} \times \frac{1 \text{ ft}}{12 \text{ in}} + (32 \times 8 \text{ ft} + 6 \times 10 \text{ ft} + 5 \times 12 \text{ ft} + 16 \text{ ft}) \times 0.25 \text{ in} \times \frac{1 \text{ ft}}{12 \text{ in}}$$

$$A_2 = [912 \text{ ft} + 183 \text{ ft} + 162.5 \text{ ft} + 36.5 \text{ ft}] \times 0.042 \text{ ft} + (392 \text{ ft} \times 0.021 \text{ ft})$$

$$A_2 = 1294 \text{ ft} \times 0.042 \text{ ft} + 392 \text{ ft} \times 0.021 \text{ ft}$$

$$A_2 = 53.9 \text{ ft}^2 + 8.2 \text{ ft}^2 = \underline{62.1 \text{ ft}^2}$$

Building 4 has : 9 Roll-up doors, 10' x 10.25'  
7 Double Sliding Doors, 10' x 10.25'

$$A_4 = [9 \times (10 \text{ ft} + 2 \times 10.25 \text{ ft}) + 7 \times (2 \times 10 \text{ ft} + 3 \times 10.25 \text{ ft})] \times 0.5 \text{ in} \times \frac{1 \text{ ft}}{12 \text{ in}} + (9 \times 10 \text{ ft}) \times 0.25 \text{ in} \times \frac{1 \text{ ft}}{12 \text{ in}}$$

$$A_4 = (274.5 \text{ ft} + 355.25 \text{ ft}) \times 0.042 \text{ ft} + 90 \text{ ft} \times 0.021 \text{ ft}$$

$$A_4 = 26.3 \text{ ft}^2 + 1.9 \text{ ft}^2 = \underline{28.2 \text{ ft}^2}$$

$$I_2 = 0.35 \times 62.1 \text{ ft}^2 \times 880 \text{ Ft}^3/\text{min} = \underline{19,127 \text{ Ft}^3/\text{min}}$$

$$I_4 = 0.35 \times 28.2 \text{ ft}^2 \times 880 \text{ Ft}^3/\text{min} = \underline{8,686 \text{ Ft}^3/\text{min}}$$

### Heat Loss

$$Q = 165,858 \text{ Btu/cfm} \cdot \text{year} \quad \text{from spreadsheet for 24 hrs/day}$$

$$Q_2 = 165,858 \frac{\text{Btu}}{\text{cfm} \cdot \text{yr}} \times 19,127 \text{ cfm} = \underline{3,172 \text{ Mbtu/yr}}$$

$$Q_4 = 165,858 \frac{\text{Btu}}{\text{cfm} \cdot \text{yr}} \times 8,686 \text{ cfm} = \underline{1,441 \text{ Mbtu/yr}}$$

### Current Energy Use

$$\#5 \text{ oil} = 3,172 \frac{\text{Mbtu}}{\text{yr}} \div 0.8 = \underline{3,965 \text{ Mbtu/yr}}$$

$$\#2 \text{ oil} = 1,441 \frac{\text{Mbtu}}{\text{yr}} \div 0.8 = \underline{1,801 \text{ Mbtu/yr}}$$

### Energy Savings

Energy Savings will be directly proportional to the size of the crack width around the doors.

$$A_2(\text{new}) = 1294 \text{ ft} \times 0.021 \text{ ft} + 392 \text{ ft} \times 0.01 \text{ ft} = 31.0 \text{ ft}^2$$

$$A_4(\text{new}) = 630 \text{ ft} \times 0.021 \text{ ft} + 90 \text{ ft} \times 0.01 \text{ ft} = 14.1 \text{ ft}^2$$

$$\text{Savings \% (Bldg. 2)} = 31.0 \text{ ft}^2 / 62.1 \text{ ft}^2 = 50\%$$

$$\text{Savings \% (Bldg. 4)} = 14.1 \text{ ft}^2 / 28.2 \text{ ft}^2 = 50\%$$

$$\#5 \text{ oil Savings} = 3965 \text{ mBtu/yr} \times 0.5 = \underline{1982 \text{ mBtu/yr}}$$

$$\#2 \text{ oil Savings} = 1801 \text{ mBtu/yr} \times 0.5 = \underline{900 \text{ mBtu/yr}}$$

$$\text{Total} = 1982 \frac{\text{mBtu}}{\text{yr}} + 900 \frac{\text{mBtu}}{\text{yr}} = \underline{2,882 \text{ mBtu/yr}}$$

### Energy Cost Savings

$$\#5 \text{ oil} = 1982 \text{ mBtu/yr} \times \$4.61/\text{mBtu} = \underline{\$9137/\text{yr}}$$

$$\#2 \text{ oil} = 900 \text{ mBtu/yr} \times \$4.76/\text{mBtu} = \underline{\$4284/\text{yr}}$$

$$\text{Total} = \underline{\$13,421/\text{yr}}$$

### Project Cost

$$\text{Total Project cost} = \$54,238$$

See cost estimate sheets for details

### Simple Payback

$$\text{Payback} = \text{Cost} \div \text{Annual Savings} - \text{annual replacement costs} \quad (\text{p. G-N-UP-5})$$

$$\text{Payback} = \$54,238 \div (13,421 - 6922)$$

$$\text{Payback} = \underline{8.4 \text{ years}}$$



SUBJECT ECO# G-N-UP  
DESIGNER P. Hutchins  
CHECKER \_\_\_\_\_

AEP NO 290-0379-001  
SHEET \_\_\_\_\_ OF \_\_\_\_\_  
DATE 9/27/91  
DATE \_\_\_\_\_

Calculate replacement costs for door seals  
over 25 year life

Assume failure at 5 yrs.

there replace  $\frac{1}{5}$  every year

Annual cost is  $34,612 \div 5 = \underline{\$6922}$   
(P.G-N-UP-5)

G-N-UP-4a

05/14/91

ECO Update Construction Cost Estimate  
Calculations

ECO Name: Warehouse Door Seals For Buildings 2 and 4

ECO #: G-N-UP

Year of original cost estimate: 1981

ECO "bare" costs (from original cost estimate)

Material	\$21,062
Labor	\$3,672

Escalation to 1991

Escalation rates from Engineering News Record:

From 6/80 to 1/91 = 1.393

From 6/81 to 1/91 = 1.290

Material = \$21,062 x 1.290 = \$27,163

Labor = \$3,672 x 1.290 = \$4,736

Total = \$27,163 + \$4,736 = \$31,899

Bare 1991 Escalated Costs	\$31,899
FICA Insurance (20% of Labor)	\$947
Sales Tax (6.5% of Material)	\$1,766

Subtotal	\$34,612
Overhead (15%)	\$5,192

Subtotal	\$39,804
Profit (10%)	\$3,980

Subtotal	\$43,784
Bond (1%)	\$438

Subtotal	\$44,222
Contingency (10%)	\$4,422

Subtotal (Construction Cost Input For LCCID *)	\$48,644
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SIOH (5.5% of Construction Cost)	\$2,675
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Subtotal	\$51,319
Design (6% of Construction Cost)	\$2,919

Total Project Cost	\$54,238
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\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

G-N-UP-5

N-V-7

CONSTRUCTION COST ESTIMATE				DATE PREPARED 6/22/81		SHEET OF	
<b>PROJECT</b> ENERGY ENGINEERING ANALYSIS				<b>BASIS FOR ESTIMATE</b> <input checked="" type="checkbox"/> CODE A (No design completed) <input type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____			
<b>LOCATION</b> LETTERKENNY Army Depot, Pennsylvania							
<b>ARCHITECT ENGINEER</b> REYNOLDS, SMITH AND HILLS A.E.P., INC.							
<b>DRAWING NO.</b> WAREHOUSE DOOR SEALS { 01465 244		<b>ESTIMATOR</b> NEVCE		<b>CHECKED BY</b>			
SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
DOOR SEAL	2407	FT	1.525	3672.00	6.00	16,363.00	20,040.00
SEAL RETAINER	2407	FT	-		1.25	4694.00	4694.00
SUBTOTAL				3672.00		21,062.00	24734.00
FICA (22% OF LABOR)							908.22
SALES TAX (5% OF MAIL)							1053.00
SUBTOTAL							26,595.00
OH & P (25%)							6647.25
SUBTOTAL							33,242.25
BOND (1%)							332.22
SUBTOTAL							33,576.00
CONTINGENCY (10%)							3358.00
DESIGN SUBTOTAL							36,934.00
SION (5%)							1847.00
BI (WE)							59,780.00

# LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 24

Room or Supply Air Conditions - Winter 68  
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 1  
9 AM - 5 PM 1  
5 PM - 1 AM 1

Operation Days Per Week 5

Temp. Range	Hours of Occurrence			Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
	2-9	10-17	18-1						
70	74	247	237	301	785	-4	1.08	1	0
65	69	296	217	278	791	1	1.08	1	854
60	64	269	196	236	701	6	1.08	1	4,542
55	59	249	191	209	649	11	1.08	1	7,710
50	54	221	193	202	616	16	1.08	1	10,644
45	49	218	193	206	617	21	1.08	1	13,994
40	44	237	236	239	712	26	1.08	1	19,993
35	39	289	246	286	821	31	1.08	1	27,487
30	34	304	194	258	756	36	1.08	1	29,393
25	29	184	106	152	442	41	1.08	1	19,572
20	24	124	65	90	279	46	1.08	1	13,861
15	19	75	32	57	164	51	1.08	1	9,033
10	14	54	13	26	93	56	1.08	1	5,625
5	9	18	3	9	30	61	1.08	1	1,976
0	4	9	0	2	11	66	1.08	1	784
-5	-1	3	0	1	4	71	1.08	1	307
-10	-6	1	0	0	1	76	1.08	1	82
-15	-11	0	0	0	0	81	1.08	1	0

Totals	2798	2122	2552	7472					165,858
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Total Operation Hours While Heating (and corrected for working days/week)	4776	118,470
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Avg outdoor temp while heating (F)	45.0
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G-N-UP-7

ECO UPDATE # G-P-UP

Install Strip Curtains in Buildings 2 & 4

Assumptions:

1. The space temperature is maintained at 68°F during the heating season.
2. The boiler system efficiency is 80%.
3. All doors are open a total of 0.5 hour each operating day.
4. Strip curtains reduce the heat loss through an open door by 85%. (Handbook of Energy Audits, Page 154)
5. The average winter wind velocity is 10 mph. (1987 Statistical Abstract of the United States)

Infiltration Rate:

$$I = C_v * A * V \quad \text{ASHRAE Fundamentals, 1981, pg 22.6}$$

$$C_v = \text{Wind direction factor} = 0.35 \quad (\text{for diagonal winds})$$

$$A = \text{Area of opening} = 1 \text{ ft}^2$$

$$V = \text{Wind velocity} = 10 \frac{\text{mi}}{\text{hr}} \times \frac{5280 \text{ ft}}{\text{mi}} \times \frac{1 \text{ hr}}{60 \text{ min}} = 880 \text{ ft/min}$$

$$I = 0.35 * 1 \text{ ft}^2 * 880 \frac{\text{ft}}{\text{min}} = \underline{308 \text{ ft}^3/\text{min}}$$

For one square foot of area



Heat Loss:

$$Q = 35,618 \frac{\text{Btu}}{\text{yr} \cdot \text{cfm}} \quad \text{see spreadsheet, for 8 hrs/day}$$

$$Q = 35,618 \frac{\text{Btu}}{\text{yr} \cdot \text{cfm}} \times 303 \frac{\text{cfm}}{\text{ft}^2} \times \frac{0.25 \text{ hr/day}}{8 \text{ hours/day}} \Rightarrow 0.34 \frac{\text{MBtu}}{\text{yr} \cdot \text{ft}^2}$$

Building 2 has: 6 10' x 10.25' doors  
5 12' x 10.25' doors  
1 16' x 10.25' doors

Building 4 has 16 10' x 10.25' doors

Total area of opening for each building

$$A_2 = 6 \times 10' \times 10.25' + 5 \times 12' \times 10.25' + 1 \times 16' \times 10.25' = 1394 \text{ ft}^2$$

$$A_4 = 16 \times 10' \times 10.25' = 1640 \text{ ft}^2$$

Heat Loss:

$$Q \times A_2 = 0.34 \frac{\text{MBtu}}{\text{yr} \cdot \text{ft}^2} \times 1394 \text{ ft}^2 (\text{Bldg. 2}) = 478 \text{ MBtu/yr}$$

$$Q \times A_4 = 0.34 \frac{\text{MBtu}}{\text{yr} \cdot \text{ft}^2} \times 1640 \text{ ft}^2 (\text{Bldg. 4}) = 562 \text{ MBtu/yr}$$

Current Energy Use:

- Assume building 2 is heated with #5 oil from the boilers in building 1.
- Building 4 is heated with #2 oil from the boilers in building 2.

Building 2:

$$\#5 \text{ oil} : 478 \frac{\text{MBtu}}{\text{yr}} \div 0.8 = \underline{598 \frac{\text{MBtu}}{\text{yr}}}$$

Building 4:

$$\#2 \text{ oil} = 562 \frac{\text{MBtu}}{\text{yr}} \div 0.8 = \underline{703 \frac{\text{MBtu}}{\text{yr}}}$$

Energy Savings:

Strip curtains reduce losses by 85%

$$\#5 \text{ oil} : 598 \frac{\text{MBtu}}{\text{yr}} \times 0.85 = \underline{508 \frac{\text{MBtu}}{\text{yr}}}$$

$$\#2 \text{ oil} : 703 \frac{\text{MBtu}}{\text{yr}} \times 0.85 = \underline{598 \frac{\text{MBtu}}{\text{yr}}}$$

$$\text{Total} = 508 \frac{\text{MBtu}}{\text{yr}} + 598 \frac{\text{MBtu}}{\text{yr}} = \underline{1106 \frac{\text{MBtu}}{\text{yr}}}$$

Energy Cost Savings:

$$\#5 \text{ oil} : 508 \frac{\text{MBtu}}{\text{yr}} \times \$6.61/\text{MBtu} = \underline{\$3,358/\text{yr}}$$

$$\#2 \text{ oil} : 598 \frac{\text{MBtu}}{\text{yr}} \times \$7.43/\text{MBtu} = \underline{\$4,443/\text{yr}}$$

$$\text{Savings} = \$3,358/\text{yr} + \$4,443/\text{yr} = \underline{\$7,801/\text{year}}$$

Project Cost:

Total Project Cost = \$33,799

See ECO Update Estimate Sheet for details

Simple Payback:

$$\begin{aligned}\text{Payback} &= \text{Cost} \div \text{Savings} \\ &= \$33,799 \div \$7801/\text{yr}\end{aligned}$$

$$\text{Simple Payback} = \underline{4.3 \text{ years}}$$

Calculate additional costs due to strip curtain replacement

Assume curtains replaced every 3 years

Therefore  $\frac{1}{3}$  will be replaced every year.

$$\begin{aligned}\text{Annual costs} &= \frac{\$21,569}{3} = \$7190 \\ &\quad (\text{p. G-P-UP-5})\end{aligned}$$

05/14/91

ECO Update Construction Cost Estimate  
Calculations

ECO Name: Plastic Strip Curtains For Loading Doors In Buildings 2 & 4

ECO #: G-P-UP

Year of original cost estimate: 1981

ECO "bare" costs (from original cost estimate)

Material	\$14,000
Labor	\$1,512

Escalation to 1991

Escalation rates from Engineering News Record:

From 6/80 to 1/91 = 1.393

From 6/81 to 1/91 = 1.290

Material = \$14,000 x 1.290 = \$18,055

Labor = \$1,512 x 1.290 = \$1,950

Total = \$18,055 + \$1,950 = \$20,005

Bare 1991 Escalated Costs	\$20,005
FICA Insurance (20% of Labor)	\$390
Sales Tax (6.5% of Material)	\$1,174

Subtotal	\$21,569
Overhead (15%)	\$3,235

Subtotal	\$24,804
Profit (10%)	\$2,480

Subtotal	\$27,284
Bond (1%)	\$273

Subtotal	\$27,557
Contingency (10%)	\$2,756

Subtotal (Construction Cost Input For LCCID *)	\$30,313
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SIOH (5.5% of Construction Cost)	\$1,667
----------------------------------	---------

Subtotal	\$31,980
Design (6% of Construction Cost)	\$1,819

Total Project Cost	\$33,799
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\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

6-P-UP-5



LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 8

Room or Supply Air Conditions - Winter 68  
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 0.25  
9 AM - 5 PM 0.75  
5 PM - 1 AM 0

Operation Days Per Week 5

	Temp. Range	Hours of Occurrence			Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
		2-9	10-17	18-1						
70	74	247	237	301	240	-4	1.08	1	0	0
65	69	296	217	278	237	1	1.08	1	1	256
60	64	269	196	236	214	6	1.08	1	6	1,388
55	59	249	191	209	206	11	1.08	1	12	2,441
50	54	221	193	202	200	16	1.08	1	17	3,456
45	49	218	193	206	199	21	1.08	1	23	4,519
40	44	237	236	239	236	26	1.08	1	28	6,634
35	39	289	246	286	257	31	1.08	1	33	8,596
30	34	304	194	258	222	36	1.08	1	39	8,612
25	29	184	106	152	126	41	1.08	1	44	5,557
20	24	124	65	90	80	46	1.08	1	50	3,962
15	19	75	32	57	43	51	1.08	1	55	2,355
10	14	54	13	26	23	56	1.08	1	60	1,406
5	9	18	3	9	7	61	1.08	1	66	445
0	4	9	0	2	2	66	1.08	1	71	160
-5	-1	3	0	1	1	71	1.08	1	77	58
-10	-6	1	0	0	0	76	1.08	1	82	21
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	2291					49,865

Total Operation Hours While Heating  
(and corrected for working days/week) 1465 35,618

Avg outdoor temp while heating (F) 45.0

G-P-UP-7

ECO UPDATE # G-U-UP

Install Storm Windows in Building 3

Assumptions:

1. The indoor air temperature is maintained at 68°F during the heating season.
2. Building 3 is heated 24 hours per day, 7 days per week.
3. The total annual hours that Building 3 is heated is 6687 hours/year. The infiltration heat loss factor (HLF) is 0.1659 MBtu/yr. The average outdoor temperature while heating is 45°F. Refer to bin temperature spreadsheet calculations for details.
4. The boiler/heating system efficiency is 80%.
5. Installing storm windows will reduce the infiltration cfm by 50%. Reference - 1981 ASHRAE Fundamentals, page 22.10.
6. The U-values for windows with and without storm windows are  $0.50 \frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot \text{°F}}$  and  $1.10 \frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot \text{°F}}$ , respectively.

Data From 1981 EEAP:

Area of windows = 1977 ft<sup>2</sup>

Infiltration for existing windows = 264 cfm (w/o storm sash)

Calculations:

Conduction energy savings:

$$Q_c = \Delta U \times A \times \Delta T$$

$$= (1.10 - 0.50) \frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}} \times 1977 \text{ ft}^2 \times (68 - 45)^\circ\text{F} \times 6687 \frac{\text{hr}}{\text{yr}} \times \frac{1 \text{ MBtu}}{10^6 \text{ Btu}}$$

$$= 0.60 \frac{\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}} \times 1977 \text{ ft}^2 \times 23^\circ\text{F} \times 6687 \frac{\text{hr}}{\text{yr}} \times \frac{1 \text{ MBtu}}{10^6 \text{ Btu}}$$

$$Q_c = 182.4 \text{ MBtu/yr}$$

Infiltration energy savings:

$$Q_I = \text{CFM} \times \text{HLF}$$

$$= (264 \text{ CFM} \times 0.5) \times 0.1659 \frac{\text{MBtu}}{\text{CFM} \cdot \text{yr}}$$

$$= 132 \text{ CFM} \times 0.1659 \frac{\text{MBtu}}{\text{CFM} \cdot \text{yr}}$$

$$Q_I = 21.9 \frac{\text{MBtu}}{\text{yr}}$$

$$\text{Heating energy savings} = Q_c + Q_I$$

$$= (182.4 + 21.9) \frac{\text{MBtu}}{\text{yr}}$$

$$= 204.3 \text{ MBtu/yr}$$

Fuel Oil # 5 savings =

$$204.3 \frac{\text{MBtu}}{\text{yr}} \div 0.80 = \underline{255.4 \frac{\text{MBtu}}{\text{yr}}}$$



SUBJECT Storm Windows  
LEAD  
DESIGNER WTT  
CHECKER

AEP NO  
SHEET 3 OF  
DATE  
DATE

Energy Cost Savings :

$$\text{Cost Savings} = 255.4 \frac{\text{mbtu}}{\text{yr}} \times \$4.61/\text{mbtu}$$

$$\text{Cost Savings} = \underline{\$1177/\text{year}}$$

Project implementation costs :

$$\text{Total project cost} = \underline{\$30,801}$$

See cost estimate sheets for details

Simple Payback :

$$\begin{aligned}\text{Payback} &= \text{Cost} \div \text{savings} \\ &= \$30,801 \div \$1177/\text{yr}\end{aligned}$$

$$\text{Payback} = \underline{26.2 \text{ years}}$$

05/14/91

ECO Update Construction Cost Estimate  
Calculations

ECO Name: Storm Windows For Building 3

ECO #: G-U-UP

Year of original cost estimate: 1981

ECO "bare" costs (from original cost estimate)

Material

\$7,651

Labor

\$5,911

Escalation to 1991

Escalation rates from Engineering News Record:

From 6/80 to 1/91 = 1.393

From 6/81 to 1/91 = 1.290

Material = \$7,651 x 1.290 = \$9,867

Labor = \$5,911 x 1.290 = \$7,623

Total = \$9,867 + \$7,623 = \$17,490

Bare 1991 Escalated Costs

\$17,490

FICA Insurance (20% of Labor)

\$1,525

Sales Tax (6.5% of Material)

\$641

Subtotal

\$19,656

Overhead (15%)

\$2,948

Subtotal

\$22,604

Profit (10%)

\$2,260

Subtotal

\$24,864

Bond (1%)

\$249

Subtotal

\$25,113

Contingency (10%)

\$2,511

Subtotal (Construction Cost Input For LCCID \*)

\$27,624

SIOH (5.5% of Construction Cost)

\$1,519

Subtotal

\$29,143

Design (6% of Construction Cost)

\$1,657

Total Project Cost

\$30,801

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

G-U-UP-4



ENERGY AUDIT OF INDUSTRIAL FACILITIES  
LETTERKENNY ARMY DEPOT

Operation hours per day = 24  
Operation days per week = 7

Indoor Air Temperature (F) = 68

Hour Fractions:      1 AM - 9 AM      1  
                         9 AM - 5 PM      1  
                         5 PM - 1 AM      1

Temperature Range		Hours of Occurrence			Net Hours	Delta T	Total Deg Hrs	Net Deg Hrs
		2-9	10-17	18-1				
70	74	247	237	301	785	-4	0	0
65	69	296	217	278	791	1	791	791
60	64	269	196	236	701	6	4,206	4,206
55	59	249	191	209	649	11	7,139	7,139
50	54	221	193	202	616	16	9,856	9,856
45	49	218	193	206	617	21	12,957	12,957
40	44	237	236	239	712	26	18,512	18,512
35	39	289	246	286	821	31	25,451	25,451
30	34	304	194	258	756	36	27,216	27,216
25	29	184	106	152	442	41	18,122	18,122
20	24	124	65	90	279	46	12,834	12,834
15	19	75	32	57	164	51	8,364	8,364
10	14	54	13	26	93	56	5,208	5,208
5	9	18	3	9	30	61	1,830	1,830
0	4	9	0	2	11	66	726	726
-5	-1	3	0	1	4	71	284	284
-10	-6	1	0	0	1	76	76	76
-15	-11	0	0	0	0	81	0	0
Totals		2798	2122	2552	7472		153572	153572

Total operation hours while heating  
corrected for working days/week = 6687 Hours/Yr

Total degree hours per year corrected for  
working days per week = 153572 Degree hours

Average outdoor temperature while heating = 45.0 F

# LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 24

Room or Supply Air Conditions - Winter 68  
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 1  
9 AM - 5 PM 1  
5 PM - 1 AM 1

Operation Days Per Week 7

Temp. Range	Hours of Occurrence			Total Hours	Delta T	Const.	CFM	Btu /Hr	Total Btu
	2-9	10-17	18-1						
70 74	247	237	301	785	-4	1.08	1	0	0
65 69	296	217	278	791	1	1.08	1	1	854
60 64	269	196	236	701	6	1.08	1	6	4,542
55 59	249	191	209	649	11	1.08	1	12	7,710
50 54	221	193	202	616	16	1.08	1	17	10,644
45 49	218	193	206	617	21	1.08	1	23	13,994
40 44	237	236	239	712	26	1.08	1	28	19,993
35 39	289	246	286	821	31	1.08	1	33	27,487
30 34	304	194	258	756	36	1.08	1	39	29,393
25 29	184	106	152	442	41	1.08	1	44	19,572
20 24	124	65	90	279	46	1.08	1	50	13,861
15 19	75	32	57	164	51	1.08	1	55	9,033
10 14	54	13	26	93	56	1.08	1	60	5,625
5 9	18	3	9	30	61	1.08	1	66	1,976
0 4	9	0	2	11	66	1.08	1	71	784
-5 -1	3	0	1	4	71	1.08	1	77	307
-10 -6	1	0	0	1	76	1.08	1	82	82
-15 -11	0	0	0	0	81	1.08	1	87	0
Totals	2798	2122	2552	7472					165,858

Net heat loss corrected for working days/week (Btu/cfm\*yr) = 165,858

Total Operation Hours While Heating  
(and corrected for working days/week) = 6687

Average outdoor temperature while heating = 45.0 F

ECO UPDATE # G-V-UP

Install Loading Dock Seals on Building 2

### Assumptions

1. The space temperature is maintained at 68°F during the heating season.
2. The boiler system efficiency is 80%.
3. Building 2 is operated for 8 hours per day and 5 days per week.
4. Of the existing 32 loading dock doors, 12 have had loading dock seals previously installed.
5. On an average day 12 of the 32 loading dock doors are used for 2 hours each.
6. Installing loading dock seals will reduce the gap between the truck and the door from 3" to 0.25 inches.
7. The average winter wind velocity is 10 mph. (1987 Statistical Abstract of the United States)

### Infiltration Rate

$$I = C_v * A * V \quad \text{ASHRAE Fundamentals, 1981, pg. 22.6}$$

$C_v$  = Wind direction Factor = 0.35 for diagonal winds

$$V = \text{Wind velocity} = 10 \frac{\text{mi}}{\text{hr}} \times \frac{5280 \text{ ft}}{\text{mi}} \times \frac{1 \text{ hr}}{60 \text{ min}} = 880 \frac{\text{ft}}{\text{min}}$$

A = Area of opening, for 12 doors

$$A = 12 \times [8 \text{ ft/side} \times 2 \text{ sides} + 10.25 \text{ ft/side} \times 2 \text{ sides}] \times 3 \text{ in} \times \frac{1 \text{ ft}}{12 \text{ in}}$$

$$A = 12 \times (16 \text{ ft} + 20.5 \text{ ft}) \times 0.25 \text{ ft} = 109.5 \text{ ft}^2$$

$$I = 0.35 \times 109.5 \text{ ft}^2 \times 880 \text{ ft/min} = \underline{33,726 \text{ ft}^3/\text{min}}$$

### Heat Loss

$$Q = 35,618 \frac{\text{Btu}}{\text{yr. cfm}} \quad \text{From spreadsheet, for 8 hrs/day}$$

$$Q = 35,618 \frac{\text{Btu}}{\text{yr. cfm}} \times 33,726 \text{ cfm} \times \frac{2 \text{ hr/day}}{8 \text{ hr/day}} = 300 \frac{\text{MBtu}}{\text{yr}}$$

### Current energy use

Assume building 2 is heated by #5 oil from the boilers in building 1

$$\#5 \text{ oil} : 300 \text{ MBtu/yr} \div 0.8 = 375 \text{ MBtu/yr}$$

### Energy Savings

Energy savings will be directly proportional to the size of the opening between the truck and the door.

$$\text{Savings \%} = \frac{3'' - 0.25''}{3''} \times 100 = 92\%$$

$$\#5 \text{ oil} = 375 \frac{\text{mbtu}}{\text{yr}} \times 0.92 = \underline{345 \text{ MBtu/yr}}$$

### Energy Cost Savings

$$\#5 \text{ oil} = 345 \frac{\text{mbtu}}{\text{yr}} \times \$4.61 / \text{mbtu} = \underline{\$1590/\text{yr}}$$

### Project Cost

$$\text{Total project cost} = \underline{\$28,833}$$

for 20 loading dock seals, see estimates for details

### Simple Payback

$$\text{Payback} = \frac{\text{cost}}{\text{savings}} = \frac{\$28,833}{\$1590/\text{yr}} = \underline{18.1 \text{ years}}$$



V-V-4

CONSTRUCTION COST ESTIMATE				DATE PREPARED 6/24/81		SHEET OF	
<b>PROJECT</b> ENERGY ENGINEERING ANALYSIS				<b>BASIS FOR ESTIMATE</b> <input checked="" type="checkbox"/> CODE A (No design completed) <input type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify)			
<b>LOCATION</b> LETTER KENNEDY ARMY DEPOT, PENSACOLA, FLORIDA							
<b>ARCHITECT ENGINEER</b> REYNOLDS, SMITH AND HILLS A.E.P., INC.							
<b>DRAWING NO.</b> BUILDING 3 WAREHOUSE DOCK - 5000		<b>ESTIMATOR</b> A.L. NEASE		<b>CHECKED BY</b>			
SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
DOCK SEAL MEQUINA # TS-583 / 100	32	DAN	54.15	2693.00	575.00	18,400.00	21,093.00
FICA (22% OF LABOR)							592.00
SALES TAX (5% OF MATERIAL)							920.00
SUBTOTAL							22,605.00
OH & P (25%)							5651.00
SUBTOTAL							28,256.00
BOND (1%)							283.00
SUBTOTAL							28,539.00
CONTINGENCY (10%)							2854.00
DESIGN SUBTOTAL							31,393.00
STUDY (5%)							1570.00
1981 CWF							32,963.00
1984 CWF = (32,963) / (1.12^2) (1.084) =							44,822.00
1981 DESIGN = (.06) (31,393) =							1884.00
1983 DESIGN = (1.12^2) (1884) =							2363.00

05/14/91

ECO Update Construction Cost Estimate  
Calculations

ECO Name: Loading Dock Seals For Building 2

ECO #: G-V-UP

Year of original cost estimate: 1981

ECO "bare" costs (from original cost estimate)

Material	\$11,500
Labor	\$1,683

Escalation to 1991

Escalation rates from Engineering News Record:

From 6/80 to 1/91	=	1.393
From 6/81 to 1/91	=	1.290

Material	=	\$11,500	x	1.290	=	\$14,831
Labor	=	\$1,683	x	1.290	=	\$2,170
Total	=	\$14,831	+	\$2,170	=	\$17,001

Bare 1991 Escalated Costs	\$17,001
FICA Insurance (20% of Labor)	\$434
Sales Tax (6.5% of Material)	\$964

Subtotal	\$18,399
Overhead (15%)	\$2,760

Subtotal	\$21,159
Profit (10%)	\$2,116

Subtotal	\$23,275
Bond (1%)	\$233

Subtotal	\$23,508
Contingency (10%)	\$2,351

Subtotal (Construction Cost Input For LCCID *)	\$25,859
--	----------

SIOH (5.5% of Construction Cost)	\$1,422
----------------------------------	---------

Subtotal	\$27,281
Design (6% of Construction Cost)	\$1,552

Total Project Cost	\$28,833
--------------------	----------

\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

G-V-UP-5

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 8

Room or Supply Air Conditions - Winter 68  
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 0.25  
9 AM - 5 PM 0.75  
5 PM - 1 AM 0

Operation Days Per Week 5

Temp. Range	Hours of Occurrence			Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
	2-9	10-17	18-1						
70	74	247	237	301	240	-4	1.08	1	0
65	69	296	217	278	237	1	1.08	1	256
60	64	269	196	236	214	6	1.08	1	1,388
55	59	249	191	209	206	11	1.08	1	2,441
50	54	221	193	202	200	16	1.08	1	3,456
45	49	218	193	206	199	21	1.08	1	4,519
40	44	237	236	239	236	26	1.08	1	6,634
35	39	289	246	286	257	31	1.08	1	8,596
30	34	304	194	258	222	36	1.08	1	8,612
25	29	184	106	152	126	41	1.08	1	5,557
20	24	124	65	90	80	46	1.08	1	3,962
15	19	75	32	57	43	51	1.08	1	2,355
10	14	54	13	26	23	56	1.08	1	1,406
5	9	18	3	9	7	61	1.08	1	445
0	4	9	0	2	2	66	1.08	1	160
-5	-1	3	0	1	1	71	1.08	1	58
-10	-6	1	0	0	0	76	1.08	1	21
-15	-11	0	0	0	0	81	1.08	1	0
Totals									49,865

Total Operation Hours While Heating  
(and corrected for working days/week) 1465 35,618

Avg outdoor temp while heating (F) 45.0

**OTHER CALCULATIONS**

**Low Cost/No Cost Projects**

LCNC #1

Close cargo doors when not in use - Buildings 2, 5, 6, 19 & 320

From the calculations for ECO #6-P-UP

Infiltration rate is  $308 \text{ CFM}/\text{ft}^2$  of opening

Average door opening is about  $100 \text{ ft}^2$

$$308 \frac{\text{CFM}}{\text{ft}^2} \times 100 \text{ ft}^2 \times 35,613 \frac{\text{Btu}}{\text{CFM} \cdot \text{ft}} \times \frac{1 \text{ yr}}{2080 \text{ hr}} \times \frac{1 \text{ MBtu}}{10^6 \text{ Btu}} = 0.53 \frac{\text{MBtu}}{\text{hr}}$$

Assume one door is open unnecessarily  $15 \frac{\text{min}}{\text{day}}$  in each of the five buildings -

$$5 \times 15 \frac{\text{min}}{\text{day}} \times \frac{1 \text{ day}}{\text{wk}} \times \frac{52 \text{ wk}}{\text{yr}} \times \frac{1 \text{ hr}}{60 \text{ min}} = 325 \text{ hr/yr}$$

$$0.53 \frac{\text{MBtu}}{\text{hr}} \times 325 \text{ hr/yr} = 172 \frac{\text{MBtu}}{\text{yr}}$$

Calc Fuel Oil Savings

#5/6 : Bldgs 2, 5	$2/5 \times 172 = 69 \text{ MBtu} \times 4.41 = \$303/\text{yr}$
#2 : Bldgs 6, 19, 320	$3/5 \times 172 = 103 \text{ MBtu} \times 4.98 = \$514/\text{yr}$
	<u><math>\\$817/\text{yr}</math></u>

Material Cost = \$0

Labor cost = \$0

## Turn Off Unneeded Lights

1) Building 320 & 370 Paint Booths

$$9 \text{ booths} \times 24 \frac{\text{Fixt}}{\text{booth}} \times \frac{3 \text{ lamps}}{\text{fixt}} \times \frac{10 \text{ watts} \times 1.2}{1 \text{ lamp}} \times \frac{2 \text{ hrs}}{\text{day}} \times \frac{260 \text{ days}}{\text{yr}} \times \frac{1 \text{ kw}}{1000 \text{ w}} \\ = \underline{22,913 \text{ kwh/yr}}$$

$$22,913 \text{ kwh/yr} \times \$0.0373/\text{kwh} = \underline{\$855/\text{yr}}$$

$$1 \text{ booth} \times 8 \frac{\text{Fixtures}}{\text{booth}} \times \frac{150 \text{ w}}{\text{Fixture}} \times \frac{2 \text{ hrs}}{\text{day}} \times \frac{260 \text{ days}}{\text{yr}} \times \frac{1 \text{ kw}}{1000 \text{ w}} = \underline{624 \text{ kwh/yr}}$$

$$624 \frac{\text{kwh}}{\text{yr}} \times \$0.0373/\text{kwh} = \underline{\$23/\text{year}}$$

2) Building 5-North receiving area:

$$15 \text{ lamps} \times 200 \frac{\text{watts}}{\text{lamp}} \times 2080 \frac{\text{hr}}{\text{yr}} \times \frac{1 \text{ kw}}{1000 \text{ w}} = \underline{6240 \text{ kwh/yr}}$$

$$6240 \text{ kwh/yr} \times \$0.0373/\text{kwh} = \underline{\$233/\text{yr}}$$

3) Building 6 North at conveyor:

$$4 \text{ Fixt} \times 96 \frac{\text{watt}}{\text{Fixt}} \times 8760 \frac{\text{hr}}{\text{yr}} \times \frac{1 \text{ kw}}{1000 \text{ w}} = \underline{3364 \text{ kwh/yr}}$$

$$3364 \frac{\text{kwh}}{\text{yr}} \times \$0.0373/\text{kwh} = \underline{\$125/\text{year}}$$

4) Building 4 & Bldg 19 exterior lights

$$2 \text{ lamps} \times 200 \frac{\text{w}}{\text{lamp}} \times 12 \frac{\text{hr}}{\text{day}} \times 265 \frac{\text{day}}{\text{yr}} \times \frac{1 \text{ kw}}{1000 \text{ w}} = 1752 \text{ kwh/yr}$$

$$1752 \frac{\text{kwh}}{\text{yr}} \times \$0.0373/\text{kwh} = \$65/\text{yr}$$

5) Building 7 over bin rows

$$616 \text{ Fixtures} \times 48 \frac{\text{w}}{\text{Fixt}} \times \frac{1 \text{ kw}}{1000 \text{ w}} \times 2 \text{ hr/day} \times 260 \frac{\text{day}}{\text{yr}} = 15,375 \text{ kwh/yr}$$

$$15,375 \text{ kwh/yr} \times \$0.0373/\text{kwh} = \$573/\text{yr}$$

---

$$\text{Total energy savings} = 50,268 \text{ kwh/yr}$$

$$50,268 \frac{\text{kwh}}{\text{yr}} \times \frac{3413 \text{ Btu}}{\text{kwh}} \times \frac{1 \text{ MBtu}}{10^6 \text{ Btu}} = 172 \text{ MBtu/yr}$$

$$\text{Total cost savings} = \$1874/\text{yr}$$

$$\text{Total Project Cost} = \$0$$





SUBJECT Insulate Steam Pipes  
DESIGNER P. Hutchins  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 1 OF 4  
DATE 5/29/91  
DATE \_\_\_\_\_

### LCNC #3 Insulate Steam Pipes

#### Summary

<u>Building #</u>	<u>Mat.</u>	<u>Costs</u>		<u>Savings</u>	
		<u>Labor (hrs)</u>	<u>Lab #</u>	<u>M\$TH</u>	<u>\$</u>
7	\$1862	43	\$695	865	\$4308
422	\$3192	74	\$1197	> 702	3496
<u>424</u>	_____	_____	_____	_____	_____
Totals	\$5054	117	\$1892	1567	\$1804

Labor trade - pipefitter

Buildings 7, 422 and 424 are currently overheated due to the presence of uninsulated steam supply pipes along the building ceilings and partially along walls. Energy can be saved by insulating these lines and allow the unit heaters and accompanying thermostats to control indoor setpoints.

## Insulate Steam Pipes in Building 7

### Current Energy Use:

Building 7 and Building 4 are both served by the boilers in Building 2. The average Annual Fuel oil #2 use for these two buildings is 71,995 gallons per year. Assume Building 7 uses about  $\frac{1}{3}$  of the heating energy since Building 4 is used for shipping and receiving operations.

$$71,995 \frac{\text{gal}}{\text{yr}} \times \frac{1}{3} \times 0.13869 \frac{\text{MBtu}}{\text{gal}} = 3325 \frac{\text{MBtu}}{\text{yr}}$$

#2 fuel oil

### Energy Savings:

Previous experience has shown that savings are approximately 2% to 3% per °F of overheating.

$$81^{\circ}\text{F} - 68^{\circ}\text{F} = 13^{\circ}\text{F} \text{ overheating in Bldg. 7}$$

$$13^{\circ}\text{F} \times 0.02 \frac{\text{Savings } \%}{^{\circ}\text{F}} = 0.26 \Rightarrow 26 \% \text{ savings}$$

$$3325 \frac{\text{MBtu}}{\text{yr}} \times 0.26 = \underline{865 \text{ MBtu/yr}}$$

### Energy Cost Savings:

$$865 \text{ MBtu/yr} \times \$4.98/\text{MBtu} = \underline{\$4308/\text{yr}}$$

Project Cost: 350 ft, 4" pipe, 2" F.g. ins. with all service jacket

Material = \$1862

Labor = 43 hrs (pipefitter)

Lab \$ = \$675 (③ \$16.17/hr, LEAD)

Source: Means Mech.

Cost Data, 1991

page 178



SUBJECT Insulate Steam Pipes  
LCNC #3  
DESIGNER P. Hutchins  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 3 OF 4  
DATE 5/29/91  
DATE \_\_\_\_\_

Insulate Steam Pipes - Bldgs 422 & 424

- Calculate current energy use

Buildings 422 and 424 receive steam from boilers in Bldg 423. This boiler serves several other buildings. Annual fuel use is estimated by averaging the boiler fuel consumption from the past four years and allocating the same on a square foot basis among the various buildings.

#5 Fuel Oil use F487-90

$$\frac{(90,044 + 122,030 + 84,806 + 103,610) \text{ gal/yr}}{4}$$

$$\times 149,690 \frac{\text{Btu}}{\text{gal}} \times \frac{1 \text{ MBtu}}{10^6 \text{ Btu}} = 14,987 \frac{\text{MBtu}}{\text{yr}}$$

<u>Bldgs Served</u>	<u>SF</u>	<u>Est. Energy Use (MBtu)</u> <sup>#5</sup> F.O.
421	15,963	2570
422	12,321	1985
424	18,928	3049
426	18,928	3049
431	13,601	2191
433	7300	1176
436	4436	715
437	1566	252
<u>TOTALS</u>	<u>93,043</u>	<u>14,987</u>



SUBJECT Insulate Steam Pipes  
Bldg 422 & 424  
DESIGNER P. Hutchins  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 4 OF 4  
DATE 5/29/91  
DATE \_\_\_\_\_

### Calculate energy savings

Previous experience and an often-used rule-of-thumb states that energy use for space heating varies about 2% per °F of indoor setpoint.

Bldgs 422 & 424 temperatures varied from 74°F to 82°F during the site survey. Using 78°F as an average, the annual fuel savings will be

$$(1985 + \frac{3049}{2})^{(1)} (78°F - 68°F) * 0.02 = \frac{702 \text{ MBtu/yr}}{\#2 \text{ fuel oil}^*}$$

<sup>(1)</sup> Only about half of Bldg 424 was overheated due to exposed steam pipes.

- Energy cost savings =  $702 * 4.98 = \$ \underline{3496/\text{yr}}$

- Calc. Project cost

600 ft, 4" pipe, 2" fiberglass insul. with all service jacket

Material = \$ 3192

Labor = 74 hours, pipefitter

Lab.\$ = \$ 1197 (\$16.17/hr)

LEAD

Source: Means Mech.  
Cost Data,  
1991, p. 178

\* Savings are #2 Fuel Oil since these boilers are being changed to #2

LCNC #4

Turn off frequency converters when not in use

No load kw input for Frequency converters:

$$M-6 = 7.2 \text{ kw/FC} \times 7 \text{ FC} = 50.4 \text{ kw}$$

$$\text{Solid state} = 2.9 \text{ kw/FC} \times 3 \text{ FC} = 8.7 \text{ kw}$$

The F-C's are not used 1 shift per day or on weekends

$$\left( 8 \text{ hr/day} \times 5 \frac{\text{days}}{\text{wk}} + 24 \text{ hrs/day} \times 2 \frac{\text{day}}{\text{wk}} \right) \times 52 \frac{\text{wk}}{\text{yr}}$$

$$(40 \text{ hr/wk} + 48 \text{ hr/wk}) 52 \text{ wk/yr} = 4576 \text{ hr/yr}$$

$$\text{Savings} = (50.4 \text{ kw} + 8.7 \text{ kw}) \times 4576 \text{ hr/yr}$$

$$= 59.1 \text{ kw} \times 4576 \text{ hr/yr} = \underline{270,442 \text{ kw/yr}}$$

$$\text{Cost Savings} = 270,442 \frac{\text{kwh}}{\text{yr}} \times \$0.0373/\text{kwh} = \underline{\$10,037/\text{year}}$$

Total Project Cost = \$0

LCNC #5

Fix Strip Curtains at Conveyor Entrance - Building 6

The strip curtains are in place, but they have been folded up which exposes the opening.

From the calculations for ECO #G-P-UP

infiltration is 308 CFM/Ft<sup>2</sup> of opening

$$10\text{ft}^2 \text{ opening} \times 308 \frac{\text{CFM}}{\text{Ft}^2} = 3080 \text{ CFM}$$

Current Energy Use:

$$3080 \text{ CFM} \times 0.165858 \frac{\text{MBtu}}{\text{CFM} \cdot \text{Yr}} \div 0.8 = 639 \frac{\text{MBtu}}{\text{Yr}}$$

Energy Savings: 85% with strip curtains

$$639 \frac{\text{MBtu}}{\text{Yr}} \times 0.85 = \underline{543 \text{ MBtu/Yr}} \text{ fuel oil \#2}$$

Energy Cost Savings:

$$543 \text{ MBtu/Yr} \times \$4.98/\text{MBtu} = \underline{\$2704/\text{Yr}}$$

Project Cost:

$$\text{Material} = \$0, \text{ Labor} = 0.25 \text{ MH} \times \$16.76/\text{MH} = \$4$$

$$\text{Total Project Cost} = \underline{\$4}$$

LCNC #6

Install Motion Sensors - to Control Lighting - Building 431

Current Energy Use :

Operating hours = 6am - 4:30 pm , 5 days/wk

$$10.5 \text{ hr/day} \times 5 \frac{\text{day}}{\text{wk}} \times 52 \text{ wk/yr} = 2730 \text{ hr/yr}$$

$$85 \text{ Fixt} \times 192 \frac{\text{W}}{\text{Fixt}} \times \frac{1 \text{ kW}}{1000 \text{ W}} \times 2730 \text{ hr/yr} = 44,554 \text{ kWh/yr}$$

Energy Savings :

Assume each lab is only occupied for 5hrs/day

$$\text{Savings} = \frac{10.5 - 5}{10.5} = 0.52 \Rightarrow 52\%$$

$$44,554 \text{ kWh/yr} \times 0.52 = 23,168 \text{ kWh/yr} \times \frac{3413 \text{ Btu}}{106 \text{ kWh}} = 79.1 \text{ MBtu/yr}$$

Energy Cost Savings :

$$23,168 \text{ kWh/yr} \times \$0.0373/\text{kWh} = \$864/\text{yr}$$

labor - electrician

Project Cost :

$$\text{Material} : 7 \text{ sensors} @ \$50 \text{ each} = \$350$$

$$\text{Labor} : 7 \text{ sensors} \times 2 \text{ hrs} \times \$16.76/\text{hr} = \$235$$

$$\text{Total Project Cost} = \$585$$

LCNC #6 - Continued

Motion sensors for Building 14 (shipping & receiving)

Operating hours : 40 hrs / week , 2080 hrs / yr

$$48 \text{ Fixtures} \times 192 \text{ w/fixt} \times \frac{1 \text{ kw}}{1000 \text{ w}} = 9.216 \text{ kw}$$

Energy Savings: If lights are off for 25% of the day

$$9.216 \text{ kw} \times 2080 \text{ hr/yr} \times 0.25 \times 3.413 \frac{\text{Btu}}{\text{kwh}} \times \frac{1 \text{ MBtu}}{10^6 \text{ Btu}} = \underline{16.4 \text{ MBtu/yr}}$$

Energy Cost Savings

$$16.4 \text{ MBtu/yr} \times 10.94 \text{ \$/MBtu} = \underline{\$179/\text{year}}$$

Project Cost

$$1 \text{ sensor @ \$50 each} = \$50$$

$$1 \text{ sensor} \times 2 \text{ manhours @ \$16.76 / MH} = \$34$$

$$\text{Total cost} = \$84$$



## Repair Steam Leaks

A 1/8" (0.125") opening in a 15 psig steam valve or fitting wastes about 250 mBtu/yr of steam (from chart on following page.)

$$250 \frac{\text{mBtu}}{\text{yr}} \div 0.80 = \underline{312 \frac{\text{mBtu}}{\text{yr}} \text{ fuel oil savings per leak}}$$

Assuming all leaks are steam produced by #5 or #6 fuel oil:

$$312 \frac{\text{mBtu}}{\text{yr. leak}} \times \$4.41/\text{mBtu} = \underline{\$1376/\text{yr per leak}}$$

Total of 3 leaks  $1376 \times 3 = \underline{\underline{\$4128}}$

Project Cost:

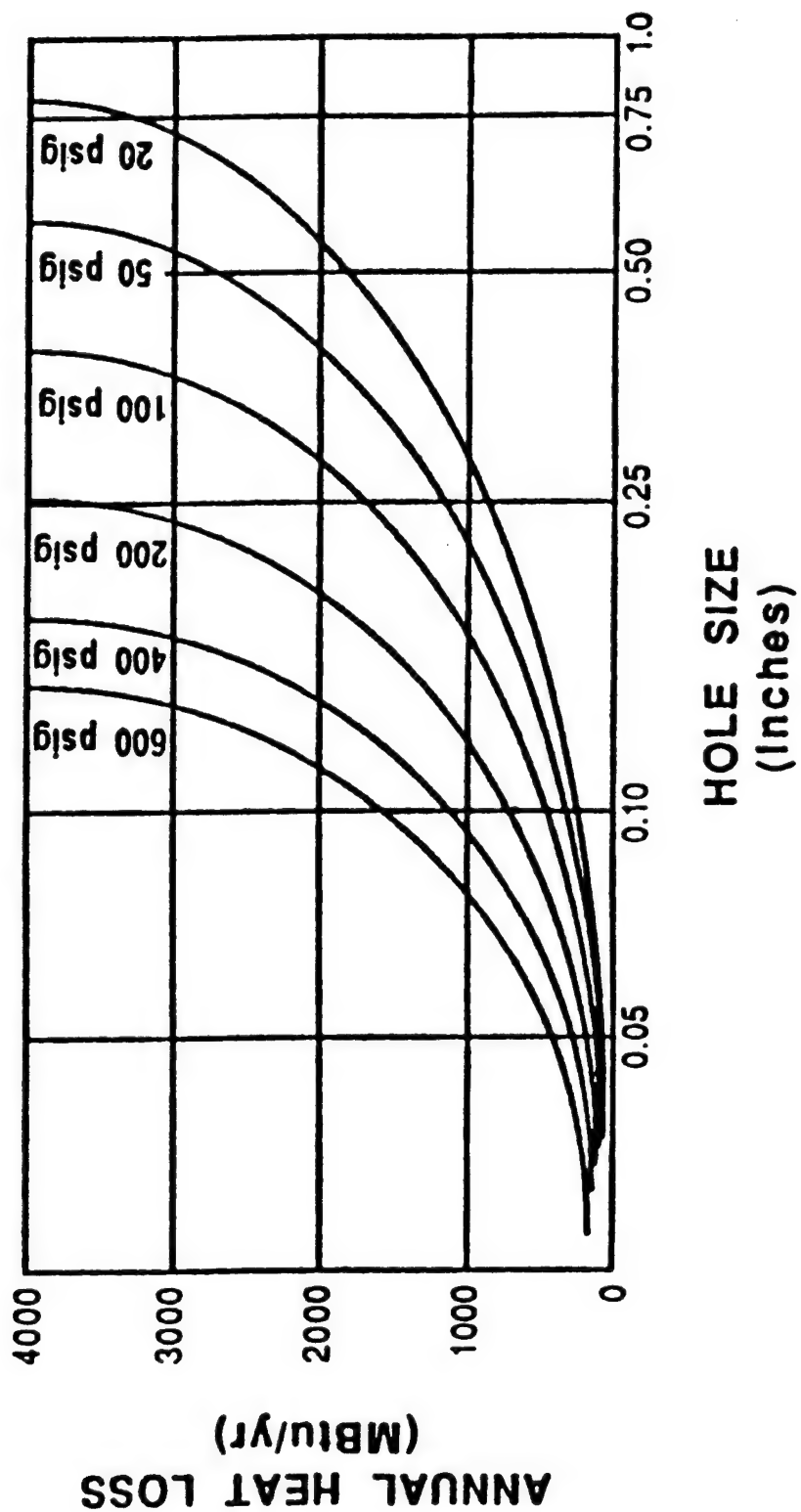
Assume all leaks are from 4" valves \*

Labor: 5.33 manhours per valve  $\times 3 \text{ valves} = 16 \text{ manhours}$   
 $16 \times 16.17^* = \underline{\$259}$

Mat: 4" Multipurpose valve =  $\underline{\$635/\text{valve} \times 3 = \underline{\$1905}}$

\* From Means 1991 Mechanical Cost Data, pg 200

# CALCULATED HEAT LOSS DUE TO STEAM LEAKS



LCNC #8  
Repair Compressed Air Leaks

Energy & Cost Savings:

From ASHRAE, a  $\frac{1}{32}$ " hole wastes \$252/yr at \$0.04/kwh

$$\text{For LEAD: } \$252/\text{yr} \times \frac{0.0373 \text{ \$/kwh}}{0.04 \text{ \$/kwh}} = \underline{\$235/\text{yr per leak}}$$

$$\$235/\text{yr} \div 0.0373 \text{ \$/kwh} \times \frac{3413 \text{ MBtu}}{\text{kwh}} = \underline{22 \text{ MBtu/yr per leak}}$$

Project Cost:

$$\text{Labor: Util. Maint. @ 2 manhours} \times \$16.17/\text{hr} = \underline{\$32/\text{leak}}$$

$$\text{Materials = Fittings/Valves @ \$75 ea} \Rightarrow \underline{\$75/\text{leak}}$$

Assuming there are 50 leaks

Energy Savings:

$$50 \times 22 \text{ MBtu/year} = 1100 \text{ MBtu/year}$$

$$50 \times \$235/\text{yr} = \$11,750/\text{year}$$

Project Cost

$$50 \times 2 \text{ MH} = 100 \text{ manhours}$$

$$\text{Labor} = 100 \times \$16.17/\text{hr} = \$1617$$

$$\text{Materials} = 50 \times \$75 = \$3750$$



SUBJECT OVERLIGHTING IN  
Bldg 424  
DESIGNER PFH.  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET 1 OF \_\_\_\_\_  
DATE 5/28/91  
DATE \_\_\_\_\_

LCNC #9 - Delamping in Bldg 424

Sewing table

There are 36, 3-tube fixtures over the sewing table and 10 more immediately to the north of the table. If half were disconnected the lighting level would be reduced from 100 fc to 50. Individual task lighting currently is available at each of the two sewing machines.

Calculate savings due to removing half of the fixtures

$$46 \text{ fixtures} \times \frac{1}{2} \times \frac{3 \text{ tubes}}{\text{fixture}} \times \frac{40 \text{ watts}}{\text{tube}} \times \frac{1 \text{ kw}}{1000 \text{ watts}}$$

$$\times \frac{3413 \text{ Btu}}{\text{kw}} \cdot \frac{1 \text{ MBtu}}{10^6 \text{ Btu}} \times \frac{5 \text{ da}}{\text{wk}} \times \frac{9 \text{ hrs}}{\text{da}} \times \frac{52 \text{ wk}}{\text{yr}} =$$

21 MBtu electricity

$$\text{Demand reduction} = 46 \times \frac{1}{2} \times 3 \times \frac{40}{1000} = \underline{2.76 \text{ kw}}$$

Dollar savings for demand reduction =

$$2.76 \text{ kw} \times \frac{\$6.59}{\text{kw} \cdot \text{mon}} \times 12 \text{ mons} = \underline{\underline{\$218}} / \text{yr.}$$

Energy only elect. savings are \$6.53/MBtu

$$\text{Total annual savings} = \underline{\underline{\$218}} + 6.53 \times 21 = \underline{\underline{\$355}} / \text{yr}$$

SUBJECT Overlighting in Bldg 424

AEP NO \_\_\_\_\_

DESIGNER PEASHEET 2 OF \_\_\_\_\_

CHECKER \_\_\_\_\_

DATE 5/24/91

DATE \_\_\_\_\_

### Cutting Table

Currently, the light level is 225 fc. Removing half of the fixtures will reduce the lighting level to about 110 fc.

Calculate energy savings -

$$50 \text{ fixtures} * \frac{1}{2} * \frac{3 \text{ tubes}}{\text{fixture}} * \frac{40 \text{ watts}}{\text{tube}} * \frac{1 \text{ kw}}{1000 \text{ watts}}$$

$$* \frac{3413 \text{ Btu}}{\text{kw}} * \frac{1 \text{ MBtu}}{10^6 \text{ Btu}} * \frac{5 \text{ da}}{\text{wk}} * \frac{9 \text{ hrs}}{\text{da}} * \frac{52 \text{ wk}}{\text{yr}} =$$

$$= \underline{24 \text{ MBtu}} / \text{yr}$$

$$\text{Demand reduction} = \frac{50 * \frac{1}{2} * 3 * 40}{1000} = \underline{3 \text{ kw}}$$

Demand reduction dollar savings =

$$3.00 \text{ kw} * \frac{\$6.59}{\text{kw} \cdot \text{mm}} + 12 \text{ mos} = \underline{\$237 / \text{yr}}$$

Electricity energy savings only are at \$6.53/MBtu

$$\text{Total annual savings} = \$237 + \$6.53 * 24 = \underline{\$394 / \text{yr}}$$



SUBJECT Overlighting - Bldg 424  
DESIGNER P. F.H.  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET \_\_\_\_\_ OF \_\_\_\_\_  
DATE 5/28/91  
DATE \_\_\_\_\_

### Bldg 424 Totals

Annual elec. savings =  $24 + 21 = 45 \text{ MBtu}$

Annual Cost savings =  $394 + 355 = \$749/\text{yr}$

### Cost of delamping

$$\frac{\frac{1}{3} \text{ hr}}{\text{fixture}} \times 96 \text{ fixtures} \times \$ \frac{16.76}{\text{hr}} = \$ \underline{536}$$

Labor hrs - 32 hrs (electrician)

## O&M Recommendations

Upon failure, replace 40-watt fluorescent lamps with 34-watt fluorescent lamps.

Energy Savings:

$$(40-34) \frac{\text{watt}}{\text{lamp}} \times 1 \text{ lamp} \times \frac{1 \text{ kw}}{1000 \text{ w}} \times 2340 \text{ hr/yr} = \underline{14 \text{ kwh/yr}}$$

Energy Cost Savings:

$$14 \text{ kwh/yr} \times \$0.0373/\text{kwh} = \underline{\$0.52/\text{yr}}$$

Project Cost:

$$\text{Material} = \$3.05 - \$2.24 = \underline{\$0.81/\text{lamp}}$$

Source: Means Electrical Cost Data, 1991, pg 201

$$\text{Add'n Labor} = \$0$$

Payback

$$\text{pay back} = \$0.81 \div \$0.52/\text{yr} = \underline{1.56 \text{ years}}$$

$$\text{Lamp life} \approx 20,000 \text{ hrs} \div 2340 \text{ hr/yr} \approx 8.5 \text{ years}$$



Upon Failure, replace standard Fluorescent ballast with energy-efficient ballast.

Energy Savings:

$$(96 - 83) \text{ w/2-lamp Fixt} \times \frac{1 \text{ Kw}}{1000 \text{ W}} \times 2340 \text{ hr/yr} = \underline{30.4 \text{ Kwh/yr}}$$

Energy Cost Savings:

$$30.4 \text{ Kwh/yr} \times \$0.0373/\text{yr} = \underline{\$1.13/\text{yr}}$$

Project Cost:

$$\text{Material} = (\$21.94 - \$15.86) \times 1.076 = \underline{\$6.54}$$

Source 5/87 vendor quote - escalated to 1/91

$$\text{Labor} = \$0 \Rightarrow \text{No additional Cost}$$

Payback

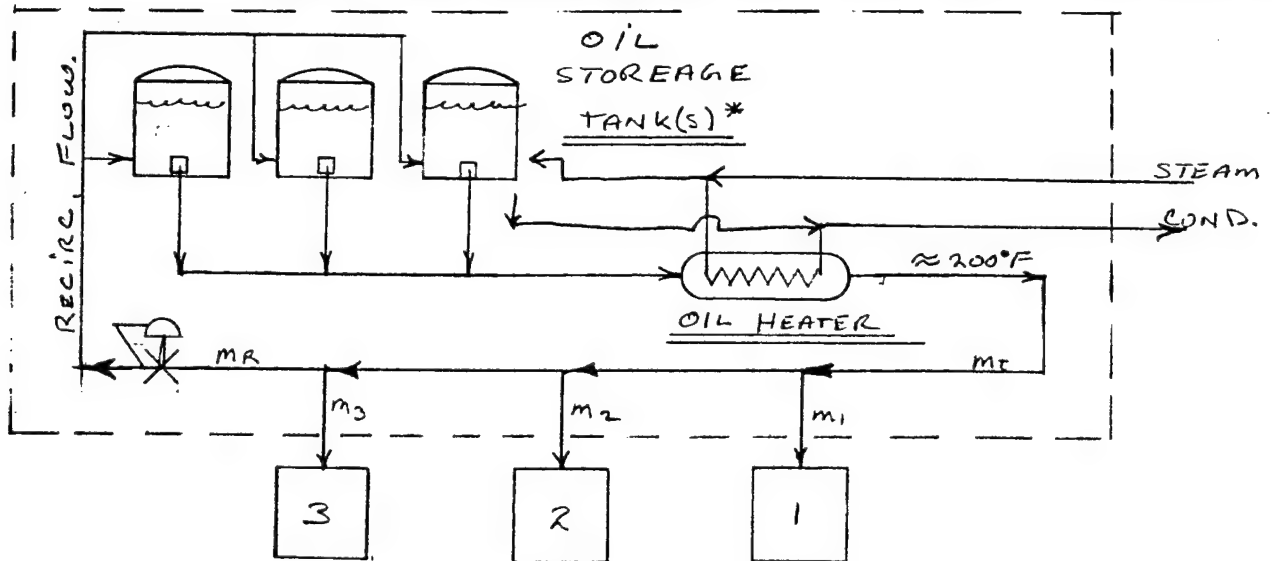
$$\text{Payback} = \$6.54 \div \$1.13/\text{yr} = \underline{5.8 \text{ years}}$$



SUBJECT LETTER KENNY A. D  
F.O. TANK OVER HEAT.  
DESIGNER \_\_\_\_\_  
CHECKER \_\_\_\_\_

AEP NO 290-0379-001  
SHEET \_\_\_\_\_ OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

FUEL TANK OVERHEATING - AUXILIARY STEAM USE - #349

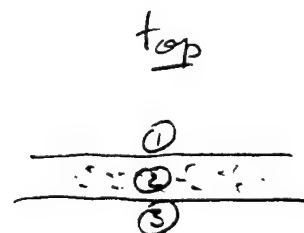
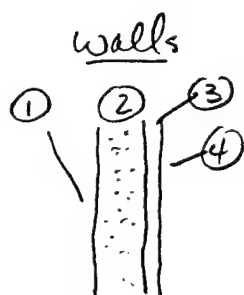
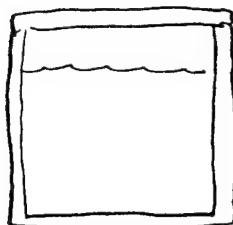


BOILERS

\*OIL STORAGE TANKS ARE INSULATED AND HEATED.

- Problem - The oil storage tanks are over-heated in the summer time. Temperatures reach 200°F when only 130°F is required.
- Calculate energy savings

- Tank heat loss



	$\frac{R}{}$
① outside air film	0.25
② 6" foam insul.	30.00
③ steel	—
④ inside film	0.68
$\Sigma R =$	30.93

$$U = \frac{1}{\Sigma R} = 0.032$$

	$\frac{R}{}$
① outside air film	0.25
② 6" foam insul.	30.00
③ inside film	0.25
$\Sigma R =$	30.50

$$U = \frac{1}{\Sigma R} = 0.033$$

Tank size  $\approx$  15' high & 18' diam.

Heat loss =  $Q = U A \Delta T$  For difference between 190°F & 130°F

$$Q = \left[ (0.032)(\pi \cdot 18 \cdot 15) + \left( \pi \frac{18}{2} \right)(0.033) \right] (190 - 130)$$

$$= 1820 \text{ Btu/hr}$$

$$\text{Fuel savings} = 90 \text{ da} \cdot 24 \text{ h/da} \cdot 1820 \text{ Btu/hr} \div 146 = 4 \text{ MBtu}$$

$$\text{Cost savings} = \$15/\text{yr} - \text{negligible}$$

V - 20a



SUBJECT O&M Savings -  
Frequency Converters - B.370  
DESIGNER P. Hutchins  
CHECKER \_\_\_\_\_  
AEP NO 290-0379-001  
SHEET \_\_\_\_\_ OF \_\_\_\_\_  
DATE 1/10/92  
DATE \_\_\_\_\_

- Energy use of frequency converters on nights and weekends is 33,120 kwh/yr  
(see ECO #14, Vol. II, p. 14-2)

- Annual energy savings is

$$33,120 \frac{\text{kwh}}{\text{yr}} \times 0.0373 \frac{\$}{\text{kwh}} = \underline{\underline{\$1235/\text{yr}}}$$

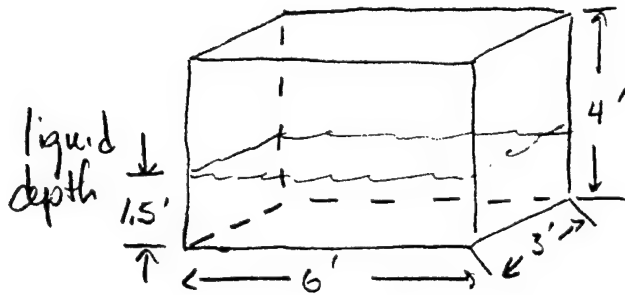


SUBJECT O&M Savings  
Vapor Degreasers  
DESIGNER P. Hutchins  
CHECKER \_\_\_\_\_

AEP NO 290-0375-001  
SHEET \_\_\_\_\_ OF \_\_\_\_\_  
DATE 1/10/92  
DATE \_\_\_\_\_

- Calculate energy use in vapor degreasers

a typical tank is about 3' x 6' x 4'  
and holds 200 gallons of 1,1,1 TCE.  
The liquid is heated to ~ 80°F. The  
liquid depth is 1.5 ft.



$$200 \text{ gal} \times \frac{\text{cf}}{7.5 \text{ gal}} = 26.7 \text{ cf}$$

$$\frac{26.7 \text{ cf}}{18 \frac{\text{cf}}{\text{sf}}} = 1.5 \text{ ft} \quad \text{liquid depth}$$

- Calculate heat loss

Tank Side  
air || liq

	R-Value
Outside air film	1.35
Steel plate	~
$\Sigma R$	1.35

$$u = \frac{1}{\Sigma R} = 0.74$$

V-C

Horizontal Surface

u is estimated  
at 500 Btu/hr/ft<sup>2</sup>/°F  
ref.: Heat Transfer, Holman  
p. 13.

SUBJECT O&M Savings - U.D.

AEP NO \_\_\_\_\_

SHEET \_\_\_\_\_ OF \_\_\_\_\_

DESIGNER \_\_\_\_\_

DATE \_\_\_\_\_

CHECKER \_\_\_\_\_

DATE \_\_\_\_\_

- Heat loss from tank sides

$$Q_s = U \cdot A \cdot \Delta T =$$

$$A = 6 \times 1.5 \times 2 + 3 \times 1.5 \times 2 = 27 \text{ sf}$$

$$Q_s = (0.74)(27)(80 - 65) = 300 \text{ Btu/hr}$$

- Heat loss from surface of liquid

$$Q_L = h \cdot A \cdot \Delta T$$

$$= (500)(18)(15)$$

$$= 135,000 \text{ Btu/hr}$$

- Calculate annual fuel use for heating

$$\#6 \text{ Fuel Oil} = (Q_s + Q_L) \times \frac{8760 \text{ hrs}}{\text{yr}} \div \text{b/r eff}$$

$$= (300 + 135,000) \times 8760 \div 0.80$$

$$= 148 \text{ MBtu/yr}$$

$$\text{Cost} = 148 \times \$4.4/\text{MBtu} = \underline{\underline{\$650/\text{yr}}}$$

SUBJECT OSM Savings - V.D.

AEP NO \_\_\_\_\_

SHEET \_\_\_\_\_ OF \_\_\_\_\_

DESIGNER \_\_\_\_\_

DATE \_\_\_\_\_

CHECKER \_\_\_\_\_

DATE \_\_\_\_\_

- Calculate cooling energy use:

Cooling energy requirements at peak capacity  
are ~1kw (source: Ultracool)

$$E_{elec} = 1 \text{ kw} * 0.75 \text{ utilization} * 8760 \frac{\text{hr}}{\text{yr}} = 6570 \frac{\text{kwh}}{\text{yr}}$$

$$\text{Costs} = 6570 \frac{\text{kwh}}{\text{yr}} * \frac{\$0.0373}{\text{kwh}} = \underline{\$250/\text{yr}}$$

Total annual energy costs:

$$\$6 \text{ F.O} + E_{elec} =$$

$$\$650 + \$250 = \$900/\text{yr.}$$



SUBJECT Oil Savings - V.D.

AEP NO \_\_\_\_\_

SHEET \_\_\_\_\_ OF \_\_\_\_\_

DESIGNER \_\_\_\_\_

DATE \_\_\_\_\_

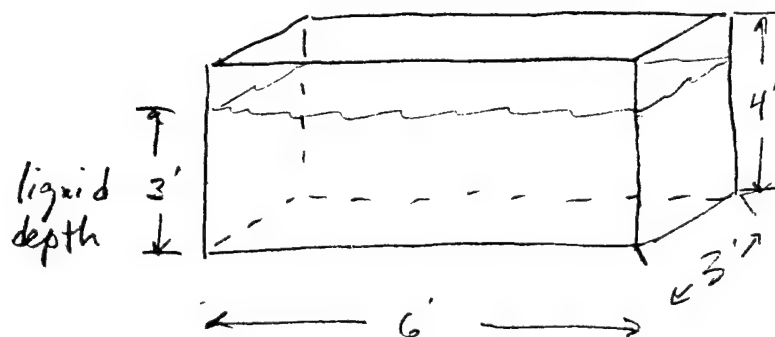
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- Calculate energy use in V.D. with non-toxic solvent

Cooling is not required - liquid should be heated to about 120°F.

- Calculate heat loss from tank



Tank Sides  
air || lig.

Horizontal Surface

	<u>R-value</u>	
outside air film	1.35	0.17
steel plate	~	—
$\Sigma R$	1.35	0.17
$U = \frac{1}{\Sigma R} =$	0.74	5.9



Total surface area (vertical) is:

$$A_H = 3 \times 3 \times 2 + 6 \times 3 \times 2 = \underline{54 \text{ sf.}}$$

Total heat loss from tank sides =

$$Q_s = U \cdot A \cdot \Delta T = (0.74)(54)(120 - 70) \approx$$

2000 Btu/hr

Heat loss from surface of liquid  $\approx$

$$Q_L = h \cdot A \cdot \Delta T = (5.9)(18)(50) = 5310 \text{ Btu/hr.}$$

Calculate annual fuel use for heating:

$$\# \text{ of F.O.} = (Q_s + Q_L) \times \frac{8760 \text{ hrs}}{\text{yr}} \div \text{blr eff}$$

$$(2000 + 5310) \times \frac{8760 \text{ hrs}}{\text{yr}} \div 0.80 = 44 \frac{\text{MBtu}}{\text{yr}}$$

$$\text{Cost} = 44 \frac{\text{MBtu}}{\text{yr}} \times \frac{\$4.4}{\text{MBtu}} \approx \underline{\$200/\text{yr}}$$



SUBJECT O&M Savings - U.D.

AEP NO \_\_\_\_\_

SHEET \_\_\_\_\_ OF \_\_\_\_\_

DESIGNER \_\_\_\_\_

DATE \_\_\_\_\_

CHECKER \_\_\_\_\_

DATE \_\_\_\_\_

Calculate energy savings

$$= \$900 - \$200 = \$\frac{700}{\text{yr}} \text{ per tank}$$

For all 9 tanks

$$\$700 \times 9 = \$\underline{6300} / \text{yr.}$$



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# PF<sup>TM</sup>

## A SAFE 100% VOLATILE INDUSTRIAL DEGREASER SOLVENT



***An Outstanding Replacement  
for 1,1,1 Trichloroethane,  
Freon, MEK, Acetone,  
Mineral Spirits, and Other  
Potentially Harmful Solvents.***

PF is a full strength solvent degreaser that combines safety, cleaning effectiveness, and total evaporation (typically less than 25 parts per million non-volatile residue). During PF's formulation, user safety and environmental compatibility were prime considerations.

PF may be used as a 1 for 1 replacement for almost all of the hazardous solvents used in industry. For most applications, PF offers full strength solvent effectiveness without any environmental or personnel concerns. It evaporates at a slightly slower rate than water. Complete evaporation may be achieved within 5 minutes by using forced air or wiping dry with a clean cloth.

PF does not contain any halogenated solvents or suspected carcinogens, teratogens or mutagens. PF, as it is shipped from the factory, is not listed or defined as a hazardous waste; therefore, for most applications, PF does not require the use of hazardous chemical waste handling and disposal methods. PF is classified as a combustible liquid (TCC FLASH POINT of over 140° F.) It is combustible under specific conditions not encountered during routine industrial use.

PF may be used for nearly all industrial applications where a 100% volatile solvent is preferred. Whether the application is wipe or spray on, tank or pail dipping, parts washers, ultrasonic, or flow rinsing, PF can be used to remove hydrocarbon, silicone, or polyethylene based greases, oils, tars, or gels.

PF has passed common carrier aircraft metals compatibility testing, and is safe to use prior to painting, and on painted surfaces.

PF is available in packages that meet any industrial situation. PF may be purchased in pints or quarts with optional trigger sprays, 1 gallon jugs, 3.5 gallon pails, 5 gallon pails, and 55 gallon drums. Larger bulk containers are available upon special request.



**TECHNOLOGIES, INC.**

Project No. 290-0379-001

 Local                      L.D. ✓ Placed ✓ Rec'd.                      Date 12/13/91
P. Hutchins Conversed With Craig Muner

 Of LEAD Regarding Vapor Degreasers

CM said that there are 9 VD's at LEAD

Bldg 37	3	(1 here is just being activated)
Bldg 370	1	
Bldg 350	2	
Bldg 1N	3	
	<u>9</u>	

In FY 91 8200 gallons of 1,1,1 TCE was disposed <sup>COST</sup> \$13,200  
 2800 pounds of sludge was disposed \$9000

CM is getting the purchase cost of 1,1,1 TCE

The advantages of a vapor degreaser are:

- Vapor carries dirt away from part, condenses and falls into bottom of tank
- Fast
- Dries very clean

Mike Miles should tell me more about VD supplier -  
 Ultracool (X5304)

Distribution:

I-20k

Project No. 290-0379-091

 Local            L.D. ✓ Placed ✓ Rec'd.            Date 1/9/92

 Of P. HUTCHINS Conversed With Bob Canavan  
PT Technologies Regarding Degreasers

- PT leaves less than 1000 parts/million residue
- Only restrictions are - Jet Engines & Electronic Bds
- Cannot be heated above 120°F due to combustibility problems
- Does not dissolve in water therefore must be treated usually in incinerator (20,000 Btu/hr)
- TCE want be available in a few year
- Non-hazardous petroleum distillate  
\$50/60 per drum cost
- Costs - small quantities \$640 / 55 gal drum  
                     5-10 drums \$530  
                     > 10 \$500
- Annual use will be 1/2 of TCE
- Army inst. using PF - Sharpe, Redstone, Aberdeen

Distribution:

Project No. 290-0379-00

Local            L.D. ✓ Placed ✓ Rec'd.            Date 1/8/92

P. HUTCHINS

Conversed With Mike Miles

Of LEAD

Regarding VAPOR DEGREASERS

MM :

Ultracool

Royce Staffer

(215) 367-2019

Al Hartman

~~\$\$\$~~ \$500 maintenance / ~~per~~ tank / yr.

Each machine has its own unit Refrig. Unit  
Carl Henry X9116

Distribution:

Project No. 290-0379-001

Local            L.D. ✓ Placed ✓ Rec'd.            Date 1/8/92

P. HUTCHINS Conversed With Al Hartman / Royce Staffer

Of Ultracool Regarding Vapor Degreasers

### Cooling Energy Use

<u>tank size</u>	<u>Compressor</u> <u>Motor</u>	<u>Cooling Cap</u> <u>( Btu/hr)</u>	<u>Energy</u> <u>Use (watts)</u>
3' x 6'	1 hp -40°F	2600	1000
4' x 8'	2 hp -40°F	5390	1600

TCE Bolds at ~ 165°F

Distribution:





SUBJECT O&M Energy Savings  
Pneu vs Elec. Tools  
DESIGNER Hutchins  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET \_\_\_\_\_ OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

## Pneumatic vs. Electric Tools

- Calculate energy requirements for pneumatic tool and compare to electric tool
- Calculate pneumatic tool energy requirements

A 1 hp air motor requires 25 CFM  
at 10-90 psig, ref: Scales Air Compressor Corp.  
Carle Place, NY

$$\text{Energy Use}_{\text{Pneumatic}} E_p = \frac{23 \text{ Bhp} \times 25 \text{ CFM} \times 0.746 \frac{\text{kW}}{\text{Bhp}}}{100 \text{ CFM} \times 0.9}$$

motor eff = 0.9

compressor eff = 23 Bhp / 100 CFM

$$E_p = 4.77 \text{ kW}$$

- Calculate comparable electric tool energy requirement:

$$E_e = \frac{1 \text{ Bhp} \times 0.746 \frac{\text{kW}}{\text{Bhp}}}{0.9} = 0.83 \text{ kW}$$

$$E_p / E_e = 4.77 \text{ kW} / 0.83 \text{ kW} = \underline{\underline{5.75}}$$

Therefore, electric tools use about 1/6 the energy of a pneumatic tool.



SUBJECT O&M Savings  
Pneum. Tools & Elec  
DESIGNER Hutchins  
CHECKER \_\_\_\_\_

AEP NO \_\_\_\_\_  
SHEET \_\_\_\_\_ OF \_\_\_\_\_  
DATE \_\_\_\_\_  
DATE \_\_\_\_\_

- Calculate dollar savings per tool

Assume 1 hp air motor use 25 CFM  
Operates 4 hr/day  
Elec. Cost = \$0.0373/kwh

$$\begin{aligned} \text{Cost}_p &= \frac{23 \text{ bhp}}{100 \text{ CFM}} \times 25 \text{ CFM} \times \frac{4 \text{ hr}}{\text{day}} \times \frac{50 \text{ wk}}{\text{yr}} \times \frac{5 \text{ days}}{\text{wk}} \\ &\quad \times \frac{0.746 \text{ kW}}{\text{bhp}} \div 0.9 \times \$ \frac{0.0373}{\text{kwh}} \\ &= \$ 178 / \text{tool} / \text{yr.} \end{aligned}$$

$$\begin{aligned} \text{Cost}_e &= 1 \text{ bhp} \times \frac{0.746 \text{ kW}}{\text{bhp}} \times \frac{4 \text{ hr}}{\text{day}} \times \frac{50 \text{ wk}}{\text{yr}} \times \frac{5 \text{ days}}{\text{wk}} \\ &\quad \div 0.9 \times \$ \frac{0.0373}{\text{kwh}} = \$ 31 / \text{tool} \end{aligned}$$

Savings are ≈ \$150 per tool per year

## Solar Energy Evaluations

## Solar Energy Applications

### Assumptions:

1. Hot water for processes such as dip tanks and pressure washing can be supplied by flat plate type collectors.
2. Solar collector efficiency is 65%.
3. The solar energy will be displacing Fuel oil #2 which currently costs \$7.43 per MBtu.
4. The maximum direct radiation available to a sun-follower at 40° North latitude is 3180 Btu per square foot per day. (ASHRAE, 1991 Applications, Page 30.10)
5. The percent possible sunshine for Harrisburg, PA is 59%. (Weather Almanac, 4th Ed., pgs 674-689.)

### Energy Savings: (Per sq. ft. of collector)

$$3180 \frac{\text{Btu}}{\text{sf. day}} \times 0.65 \times 0.59 \times 260 \frac{\text{days}}{\text{yr}} \times \frac{1 \text{ MBtu}}{10^6 \text{ Btu}} = 0.317 \frac{\text{MBtu}}{\text{sf. yr}}$$

### Energy Cost Savings:

$$0.317 \frac{\text{MBtu}}{\text{sf. yr}} \times \$7.43 / \text{MBtu} = \$2.36 / \text{sf. yr}$$

Project Implementation Cost:

Total Project Cost = \$25,752 Sec cost estimate sheets  
for details

$$\$25,752 \div 210 \text{ ft}^2 \text{ collector surface} = \underline{\$122.63/\text{sf}}$$

Simple Payback:

$$\text{Payback} = \text{Cost} \div \text{Savings}$$

$$\text{Payback} = \$122.63/\text{sf} \div \$2.36/\text{sf} \cdot \text{yr} = \underline{52.0 \text{ years}}$$

This project is not recommended.

05/29/91

# ECO Construction Cost Estimate Calculations

ECO Name: Solar Energy Process Heating Applications

ECO #: N/A

1991 ECO "bare" costs (from cost estimate sheet)

Material	\$8,822
Labor	\$5,865

Subtotal bare costs	\$14,687
---------------------	----------

FICA Insurance (20% of Labor)	\$1,173
-------------------------------	---------

Sales Tax (6.5% of Material)	\$573
------------------------------	-------

Subtotal	\$16,433
----------	----------

Overhead (15%)	\$2,465
----------------	---------

Subtotal	\$18,898
----------	----------

Profit (10%)	\$1,890
--------------	---------

Subtotal	\$20,788
----------	----------

Bond (1%)	\$208
-----------	-------

Subtotal	\$20,996
----------	----------

Contingency (10%)	\$2,100
-------------------	---------

Subtotal (Construction Cost Input For LCCID *)	\$23,096
--	----------

SIOH (5.5% of Construction Cost)	\$1,270
----------------------------------	---------

Subtotal	\$24,366
----------	----------

Design (6% of Construction Cost)	\$1,386
----------------------------------	---------

Total Project Cost	\$25,752
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\* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.



PROJECT IMPLEMENTATION CALCULATIONS



Filename : LTRER6Y.W01

Effects of Project Implementation

YR	ELC	FSD	FSR	NAG	OTH	TOTAL
USE(MBTU)						
FY87	163,813	89,803	213,230	0	3,316	470,162
FY88	165,759	112,242	232,519	0	989	511,509
FY89	170,053	101,576	219,479	0	661	491,769
FY90	169,931	107,320	188,578	0	6,664	472,493
FY91	173,117	139,736	147,914	0	6,110	466,877
FY92	173,117	139,736	147,914	0	6,110	466,877
FY93	173,117	139,736	147,914	0	6,110	466,877
FY94	167,038	131,287	111,650	0	6,110	416,085
FY95	164,398	131,287	111,650	0	6,110	413,445
FY96	164,398	18,032	0	218,369	6,110	406,909

COST(\$)						
FY87	1,943,000	486,000	997,000	0	24,000	3,450,000
FY88	2,152,000	526,000	854,000	0	12,000	3,544,000
FY89	1,712,000	476,000	806,000	0	7,000	3,001,000
FY90	1,774,000	433,000	668,000	0	20,000	2,895,000
FY91	1,921,954	1,038,238	977,712	0	20,163	3,958,067
FY92	1,904,287	698,680	650,822	0	20,163	3,273,952
FY93	1,904,287	698,680	650,822	0	20,163	3,273,952
FY94	1,837,418	656,435	491,260	0	20,163	3,005,276
FY95	1,808,378	656,435	491,260	0	20,163	2,976,236
FY96	1,808,378	90,160	0	847,272	20,163	2,765,973

ELC	FSD	NAG	OTHR	TOT
164,398	45,751	190,305	6,110	406,564
1,808,378	90,160	847,272	20,163	2,765,973

# SAVINGS BY PROJECT

ECO #	10.94 ELEC	4.98 FSD	4.41 FSR	3.88 COST
9	124		4895	\$22,944
11	1610			\$17,613
6			938	\$4,137
3	2496		26034	\$142,116
1	366			\$4,004
15	-20			(\$219)
10	1503	5674	4397	\$64,090
FY93	6079	5674	36264	\$254,685
5	2640		6536	\$57,705
16				